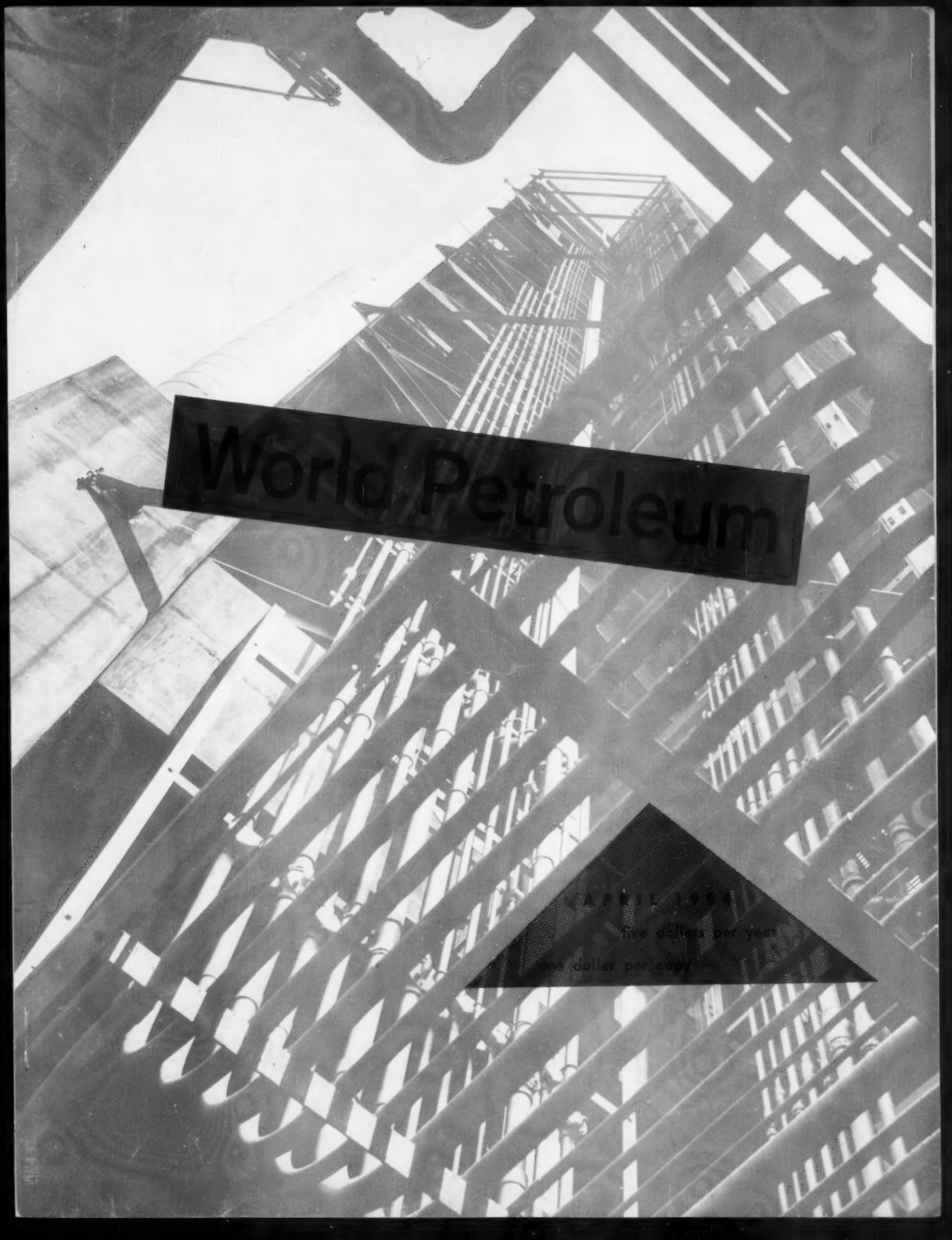
World Petroleum
APRIL 1954
five dollars per year
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Both cost 'um same money

– which one you want?

Tomorrow's Tools-Today!

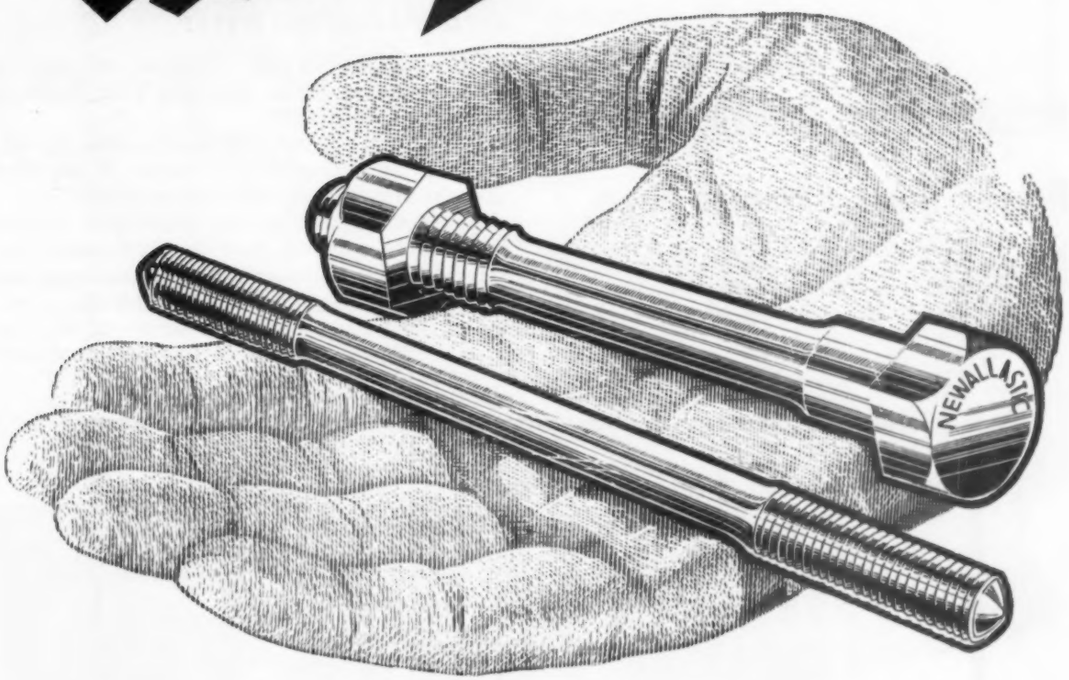
AK-701

LANE WELLS COMPANY

General Offices, Export Office, Plant • 5610 So. Soto St., Los Angeles 58

LOS ANGELES • HOUSTON • OKLAHOMA CITY • LANE-WELLS CANADIAN CO. IN CANADA • PETRO-TECH SERVICE CO. IN VENEZUELA

Unique



"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatigue than bolts or studs made by the usual method.

C. P. Newall & Co., Ltd.

POSSILPARK GLASGOW · N

What's NEW

In Perforating, Logging, and Fishing Tool Services

McCULLOUGH®
NEW SERVICES • NEW TOOLS
NEW WAYS OF DOING THINGS

Latest News About New Tools, Techniques and Services

McCullough Log Through Casing *Proves More Accurate Than* Other Log in Open Hole!

REPORT FROM THE FIELD!

This was a wildcat well. Operator ran another type gamma ray log in open hole. Then 7", 23-lb. casing was set at 7320'.

McCullough was called to run a gamma ray log, primarily as a measurement check. It indicated that the first log was eight feet in error.

However, of even greater importance, it was immediately apparent that the McCullough log through casing was clearer and sharper, recording changes in lithology that were completely missed by the first log. Another example of the far greater efficiency of the McCullough Radiation Well Logger.

"100 Times More Sensitive"

McCULLOUGH

RADIATION WELL LOGGER

Accurate, Consistent, Stable and Reliable Gamma Ray and Neutron Logs

The counter of the McCullough Radiation Well Logger, has an efficiency approaching 100% in measuring gamma radiations. It is approximately 100 times more sensitive per unit of volume than other radiation counters.

***For Best Results* Log AND Perforate**

by McCullough

Available in most active oil fields—call your McCullough Service Engineer and ask to see a log from your area.

PERFORATING, RADIATION LOGGING, AND FISHING TOOL SERVICE—ANYWHERE—ANYTIME.

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WORLD PETROLEUM for April, 1954. Vol. 25, No. 4. April, 1954. WORLD PETROLEUM is published monthly by Mona Palmer, Trustee under the will of Russell Palmer, 604 Fifth Ave., New York 20, N. Y. Acceptance at East Stroudsburg, Pa., under Section 34.64 P. L. & R. Authorized. Subscription rate: $5.00 per year, single copies $1.00.

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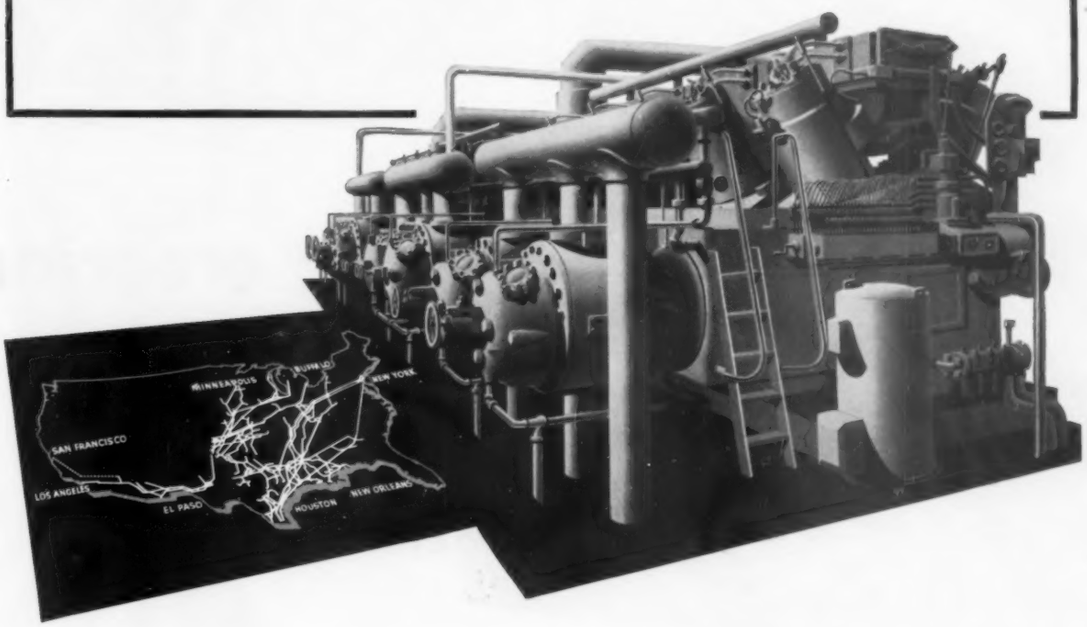
GULF SECURITY OIL

provides better lubrication
for pipe line compressor units,
helps prevent operating troubles



Here's the lubricant you can depend on to help keep your pumping stations operating smoothly and continuously—Gulf Security Oil. It provides effective protection for cylinders and bearings in both engines and compressors.

Because of its excellent resistance to oxidation, Gulf Security Oil stands up for many hundreds of hours without any appreciable change in its original properties. After years of operation with this quality lubricant, equipment shows remarkable freedom from cylinder wear and a minimum of carbon deposits on valves and rings. And because oil control rings are kept clean, oil consumption is remarkably low.

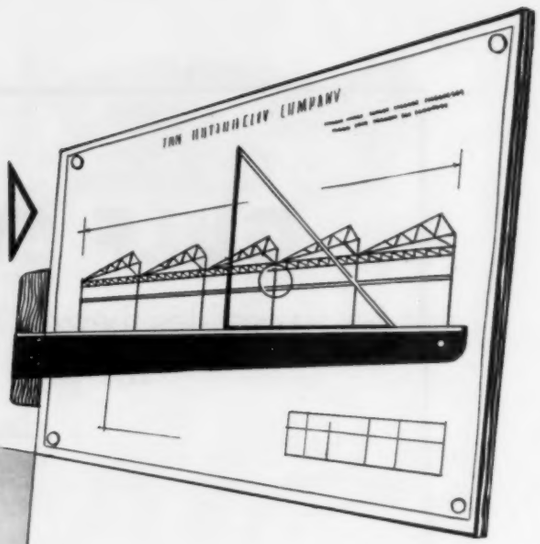
Operators of the many units lubricated with Gulf Security Oil report that this quality lubricant helps them get more operating hours between overhauls, and avoid unscheduled shutdowns.

For additional information on Gulf Security Oil and for the services of a Gulf Sales Engineer, get in touch with your nearest Gulf office today. Write, wire, or phone.

Gulf Oil Corporation · Gulf Refining Company,
Pittsburgh 30, Pennsylvania.

GULF INDUSTRIAL LUBRICATION

from drawing board



to erection on site

FOUNDED 1790

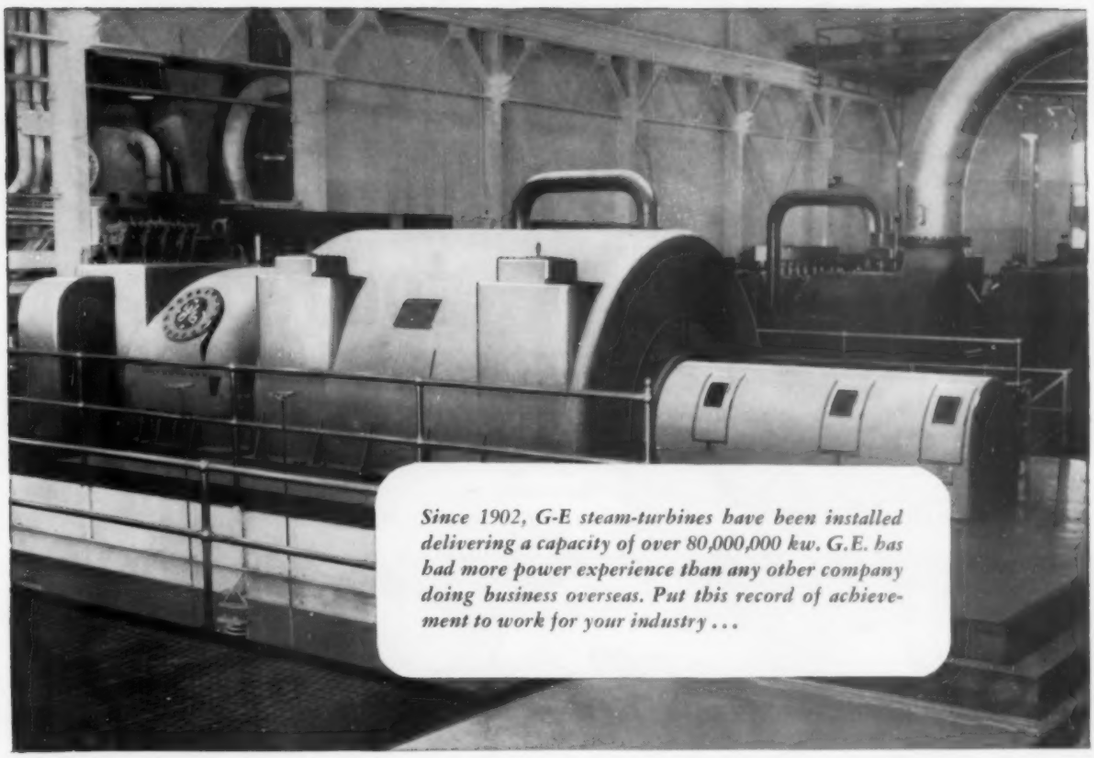
BUTTERLEY

Constructional Steelwork

The Butterley Company has been engaged in constructional steelwork from its early days and examples are to be found in all parts of the British Isles and in many countries overseas. From design, through the stages of fabrication to erection on site, every structure is invested with the skill and knowledge which have made the Butterley Company famous in the field of constructional steelwork. Welded methods are widely employed today and the shops are well-equipped to undertake the largest and heaviest work of this nature.

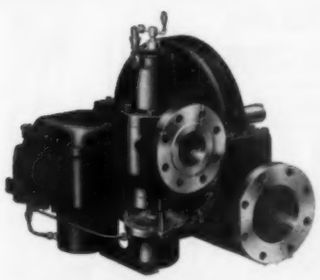
THE BUTTERLEY COMPANY LIMITED
RIPLEY, DERBY, ENGLAND
LONDON OFFICE: 20 ASHLEY PLACE, VICTORIA, S.W.1

CS-37



Since 1902, G-E steam-turbines have been installed delivering a capacity of over 80,000,000 kw. G.E. has had more power experience than any other company doing business overseas. Put this record of achievement to work for your industry . . .

Take your *power problems* to G.E.



FIND THE WAY TO COMBINE ECONOMY WITH EFFICIENCY!

An expanding company has increased power needs. Like many another, it has unique operating conditions. Space is at a premium. Installation and operating expenses must be kept at a minimum. From a basic design, G.E. built this 5000 kw turbine to meet this firm's special requirements.

PROVIDES ADAPTABILITY! Basic design adapts to various load and process requirements.

GIVES GREATER ECONOMY! Simplified design, use of standard parts means fast, easy maintenance.

SAVES SPACE! Compact design means you make fullest use of floor room.

SAVES INSTALLATION EXPENSE! Complete factory testing, assembling, inspection reduce installation time and cost.

SEE HOW A GENERATOR IS BORN... what goes into it . . . why it serves you so well. Ask your G.E. representative about the 16-mm. film "Power By Which We Live."

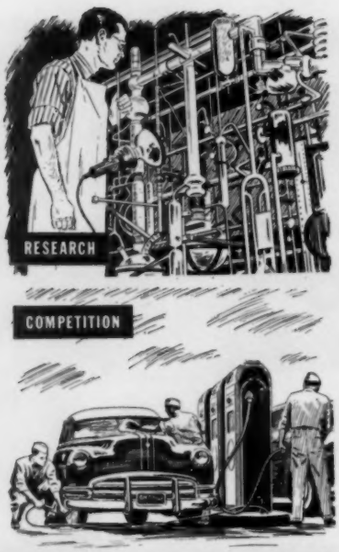
See him for all your power needs. Or write International General Electric Co., Apparatus Sales, 570 Lexington Avenue, New York 22, N.Y., U.S.A. 18-56-1B

Dependable Mechanical Drives, Too! G.E. surveyed hundreds of turbine users, asked them what a mechanical drive should do. With the answers, G-E engineers designed a full line of units with these quality features which give you long, low-cost, reliable operation:

- Combined trip throttle valve — exclusive G-E feature!
- Totally-enclosed hydraulic or oil-relayed governor!
- Accurate speed and governing control!
- Pressure oiling of bearings!
- Standardized spare parts!
- Accessible individual components!

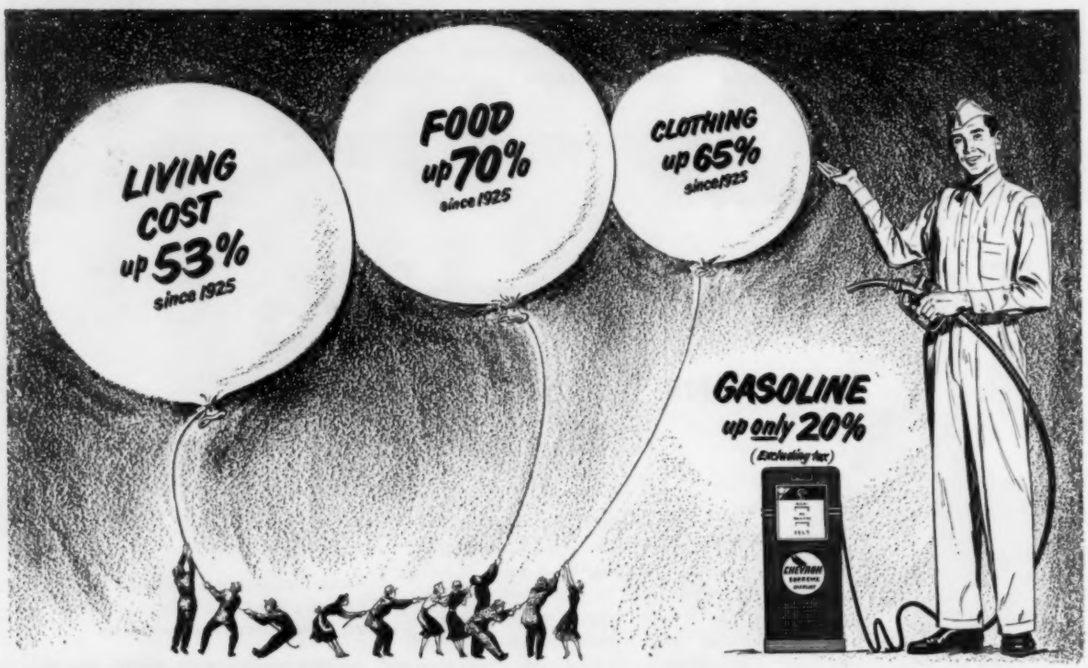
GENERAL ELECTRIC

—U. S. A.—



Why gasoline is a real bargain today

Two facts lie behind the low price you pay for gasoline: oil companies work constantly through research to improve products and keep prices low, and they *compete intensely for your patronage.* That's why Standard opened the West's first petroleum research laboratory 32 years ago—and invests about $6 million annually in research.



One result you see here. Thanks to competition, gasoline prices (aside from taxes) have risen only 20% since 1925 . . . less than half as much as practically anything else you buy. But there have been other benefits for you, too. Research, motivated by competition, has resulted in a steadily improving gasoline. Two gallons of modern gasoline do the work that required 3 in 1925, and this has paved the way for lighter, more efficient car engines that give you more power, performance and economy. Competition and research have led to better gas station service, as well, and to the world-wide search that has discovered the largest known oil reserves in America's history. Last year, Standard Oil Company of California invested $225 million in exploration, new oil wells, improved facilities to keep pace with competition. The result is better gasoline at prices which make it one of the real bargains in your family budget.

75 years of planning ahead to serve you better

STANDARD OIL COMPANY OF CALIFORNIA

The man who is never at his desk

The girl who answers the phone for one of Ethyl's automotive engineers must have a pretty frustrating job.

These men are almost never at their desk.

You see, helping bus, truck, and taxi-fleet owners get more efficient operation is not something you can do very well from an office swivel chair. So Ethyl automotive engineers spend most of their time in the field working with oil-company sales and technical people in their contacts with the service managers of fleets.

This offers two important benefits to refiners. Ethyl customers get quick and direct cooperation. At the same time, knowledge gained from direct contact with the field enables our laboratory people to keep research directed in the most productive channels.

Our "get out in the field" operation is by no means confined to our automotive men in the field. Engineers from Ethyl's Research Laboratories are constantly at work with farm-tractor people, passenger-car builders, and airplane-engine manufacturers on developments that in the long run may prove important to gasoline refiners and distributors.

These hours our men spend away from their desks are the most valuable hours. They provide the first-hand knowledge and experience that enable us to give refiners the most effective assistance.

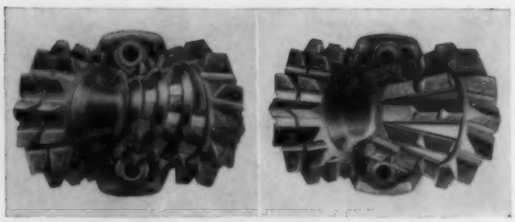
We feel—and we think you'll agree with us—that reliable technical service is an important ingredient in Ethyl antiknock service.

ETHYL CORPORATION, New York 17, N. Y.

Ethyl Antiknock Ltd., in Canada

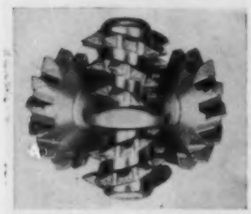
One of these REED twin-blast ROCK BITS will do a good job drilling the next formation you encounter . . .

Ask your **REED** representative for suggestions. He can often help you reduce drilling costs.



B-1 B-2

REED Barracuda Bits are available in either of the two types shown. Type B-1 has spiral teeth on the long cutter and type B-2 has axial teeth. Either type may be used according to the preference of the operator.

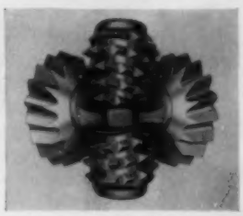


LT-3 For fast penetration of top hole and unconsolidated formations.

LT For drilling top hole and unconsolidated formations which are not exceptionally abrasive.

T For relatively non-abrasive formations such as shale, salt, red beds, soft limestone.

2T For penetrating soft formations that are interspersed with streaks of abrasive sands and shells.

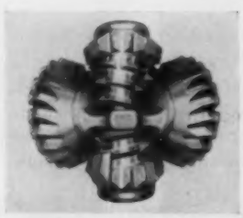


M For medium formations such as chalk, gypsum, anhydrite, etc., where penetration is 10 to 25 feet per hour.

2HM For medium hard formations where abrasive materials are encountered.

2H For moderately hard formations where a rate of penetration of 5 to 12 feet per hour is expected.

2HS-1 For heavy weight drilling of hard, abrasive formations like hard lime, chert, granite, and hard sands.



2HS-1W For drilling extremely abrasive formations with a high compressive strength.

2C For very hard and abrasive formations such as chert, hard lime and dense abrasive sands.

2CW For full gauge drilling of the hardest, most abrasive formations, where penetration is 1 to 5 feet per hour.

2CWW For chert, pyrite, granite, dolomite, and quartzite, where maximum abrasion resistance is required.

REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS

THE MARK OF QUALITY

4743

TAKES PLENTY OF
MANPOWER
to Bring You Flying Horsepower!

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CONSTRUCTION WORKERS

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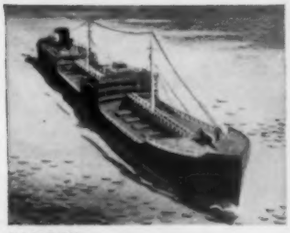
DRILLERS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REFINERY TECHNICIANS

TRUCK DRIVERS

Mobilgas
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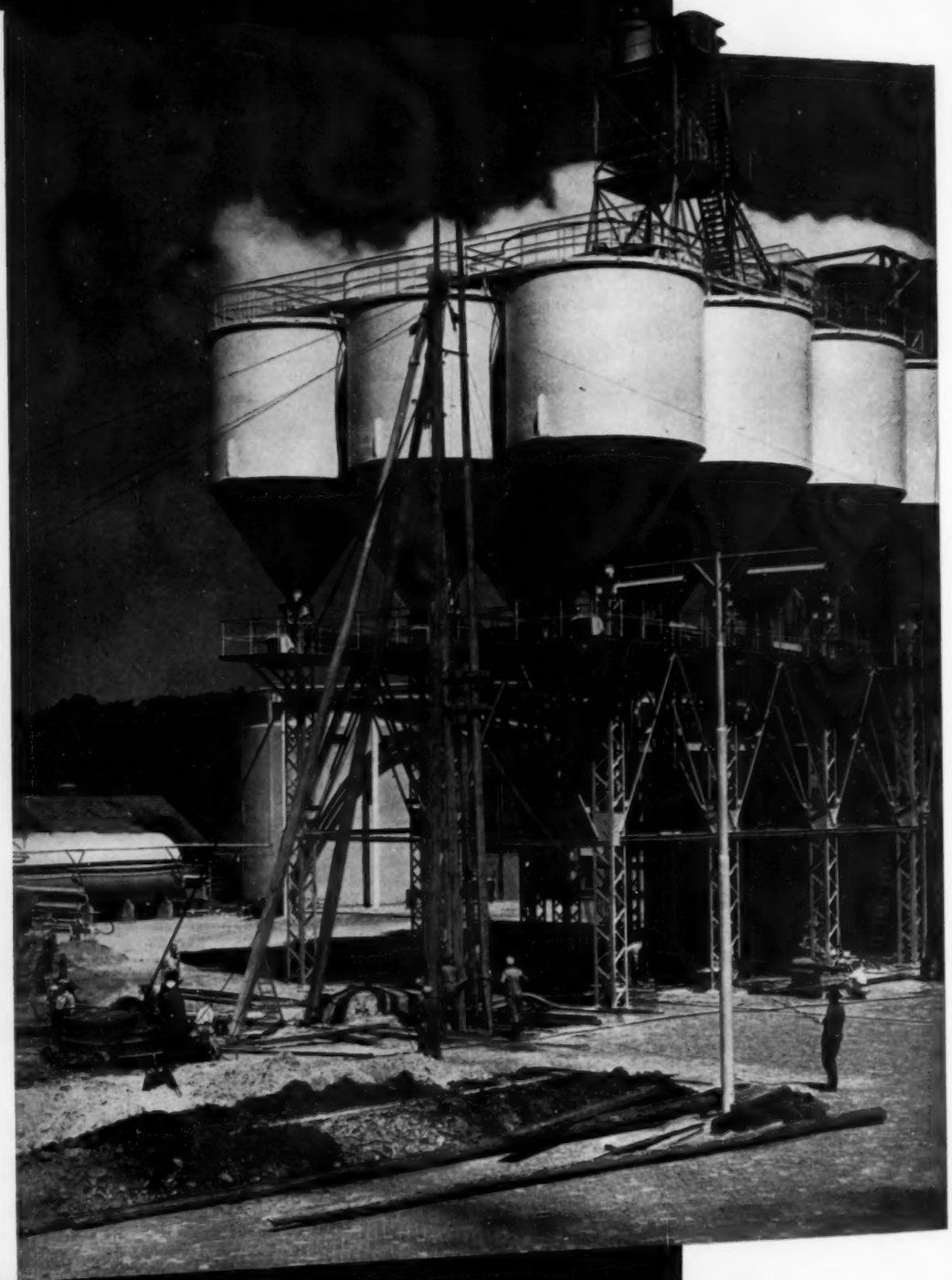
KETJENCAT

M.S. FLUID CRACKING CATALYST

based on the processes of AMERICAN CYANAMID COMPANY New York



Enlargement of the plant capacity enables us to meet the increasing demand

Koninklijke Zwavelzuurfabrieken v h

KETJEN NV AMSTERDAM - THE NETHERLANDS

Founded 1835

THE BROMINE PLANT OF THE ASSOCIATED ETHYL COMPANY LIMITED AT AMLWCH ANGLESEY

250,000 square feet of anti-corrosive rubber linings and coverings, representing one of the largest contracts for the rubber lining of chemical plant ever undertaken, were made and installed by Dunlop Rubber Company Limited, General Rubber Goods Division, Manchester.

The equipment lined included pipes, storage vessels, ducting, fans, the steel absorber unit—approximately 100 feet square by 40 feet deep—1,564 steel beams hard rubber covered of a combined total length of 4 miles and 1,000 pieces of 10″ bore mild steel piping measuring in all one third of a mile.

Rubber compounds to resist the action of hydrobromic, hydrochloric and sulphuric acids and resultant gases were used. Much of the work was lined and cured on site, but numerous items were designed in sections by The Associated Ethyl Company Limited to enable them to be cured in the 15 feet diameter curing pan at the Dunlop Manchester works.

Rubber Linings by **DUNLOP**

Manufacturers of all Industrial Rubber Products

Dunlop Rubber Co. Ltd. (General Rubber Goods Division) Manchester, England
Associated Companies and Distributors throughout the World.

to all NATURAL GASOLINE MEN

GREETINGS

from the

NATURAL GASOLINE SUPPLY MEN'S ASSOCIATION

We are looking forward to seeing you at the

THIRTY-THIRD ANNUAL CONVENTION

of the NATURAL GASOLINE ASSOCIATION of AMERICA

APRIL 21, 22 and 23, BAKER AND ADOLPHUS HOTELS,
Dallas, Texas

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Young Sales Corp.
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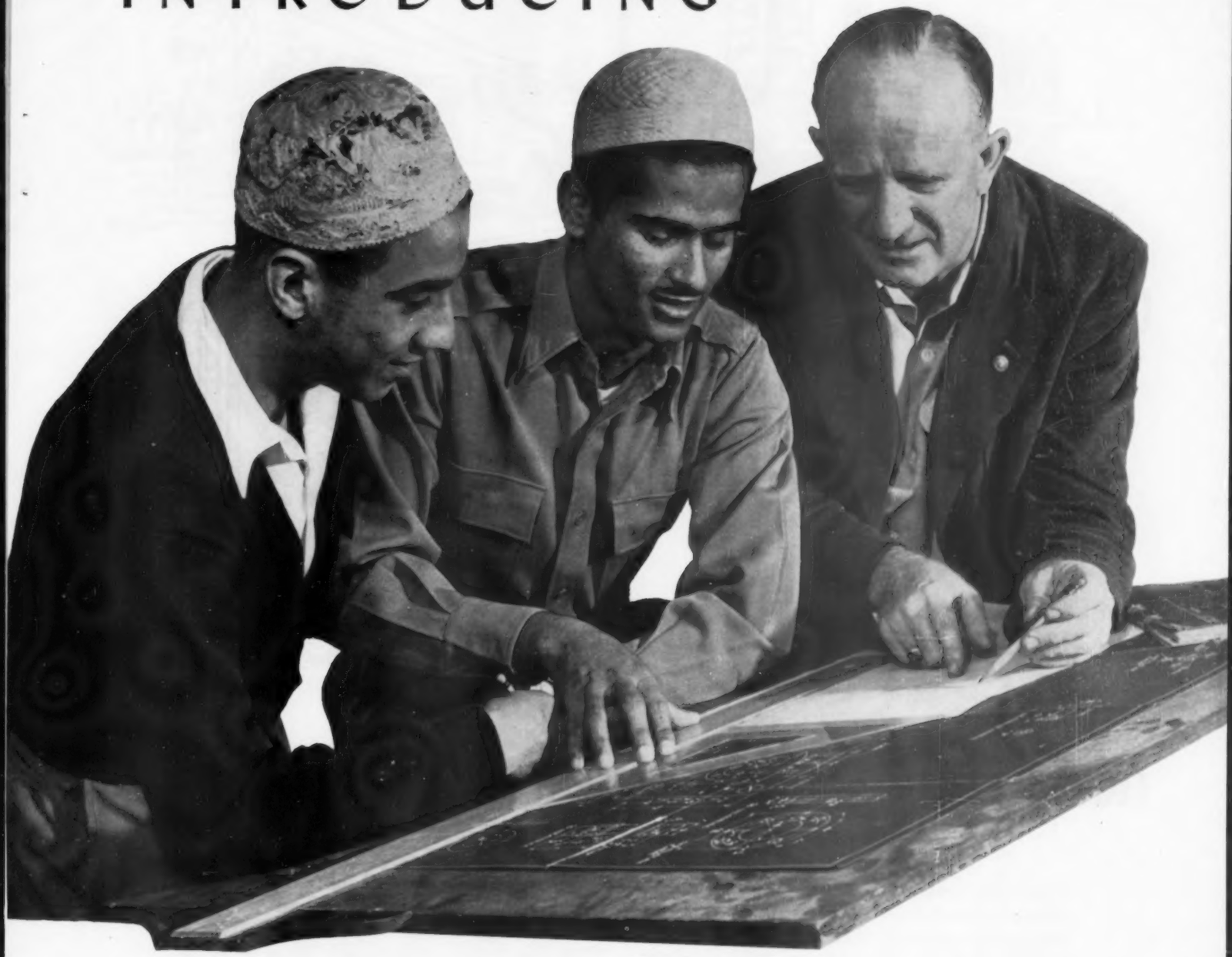
INTRODUCING

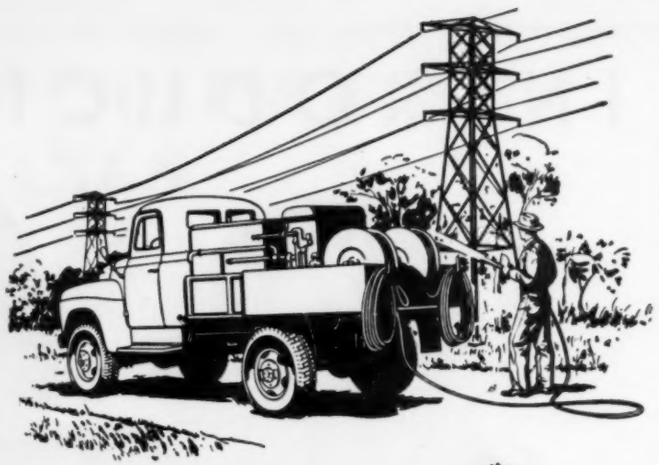


Abdul Razaq ibn Muhammad *Abdullah Rashid* *Gerald C. Dunbar*

Abdul, left, and Abdullah are being taught to read blueprints at Dhahran, Saudi Arabia, by ARAMCO's veteran vocational instructor, G. C. Dunbar. These two young Saudi Arabs soon will be applying their newly acquired skill to their oil jobs.

Aramco THE ARABIAN AMERICAN OIL CO.

DHAHRAN, SAUDI ARABIA NEW YORK, U. S. A.



Get maximum traction anywhere, anytime!

INTERNATIONAL 4-WHEEL DRIVE TRUCKS

Haul men, tools and equipment to any job . . . through ruts, mud, sand or snow . . . over terrain where conventional trucks can't go. Do *all this* with an International medium-duty four-wheel drive truck!

Two new International 4x4 models now offer you an important development in transportation efficiency. They're tough-job engineered, they're built for the hardest kind of work. Model R-140 (4x4) has a gross vehicle weight rating of 11,000 pounds, the R-160 (4x4) is rated at 15,000 lbs. GVW.

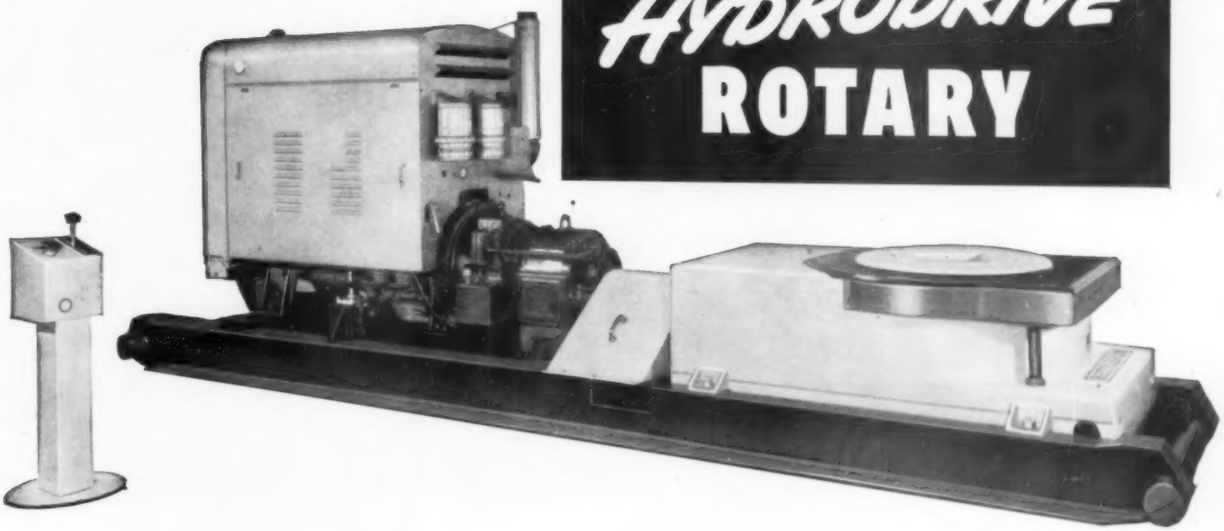
Each comes in two wheelbases, and each is available with single front and dual rear tires, or large-section single tires all around. With front axle disengaged, these International 4x4's operate normally on hard-surface roads.

Here is real stamina and versatility for the difficult hauling jobs. Find out more about the new International 4x4 models from your International Distributor now. International Harvester Export Company, 180 N. Michigan Ave., Chicago 1, U.S.A.

INTERNATIONAL TRUCKS

Better Living through Better Roads

Why you're ahead with a BETHLEHEM *HYDRODRIVE* ROTARY



While Bethlehem makes and will gladly furnish rotary tables for drawworks hook-up, we'd like to point out the many advantages of the Hydrodrive rotary unit with independent engine.

First of all, what does Bethlehem offer in this respect? We offer the two most commonly-used sizes—21-in. and 17½-in., *both standard tables.* Either is available with gas or diesel engine and *torque-converter drive.* The system has *two forward transmission ratios, one reverse.*

The flexibility—"independence"—of Bethlehem's Hydrodrive tables makes possible great gains in your drilling set-up. For instance, there's reduced wear on the drawworks. There's complete control at the driller's fingertips. There's an infinite number of speeds from zero to maximum. With separate rotary drive, you are not draining power from the drawworks engines; more power, therefore, is available for the pumps.

Here are some other advantages: greater safety (no chain drives between drawworks and table) . . . more pipe-racking space . . . ready portability (fine for rathole digging) . . . drive and controls that make the units perfect for fishing.

Bethlehem Hydrodrive tables can be used at floor level or underneath the floor, whichever you prefer. And there are other features, too, that you'll want to investigate—because they mean an easier type of drilling. Write for information; complete details will be sent promptly.

Bethlehem also manufactures a complete line of slush pumps and drawworks for shallow, medium, and deep drilling; also crown and traveling blocks, and swivels; and, for production work, pumping units in a wide range of sizes and types. Ask for literature.

BETHLEHEM STEEL

BETHLEHEM STEEL EXPORT CORPORATION

25 Broadway, New York 4, N.Y., U.S.A.

Cable Address "BETHLEHEM, NEWYORK"

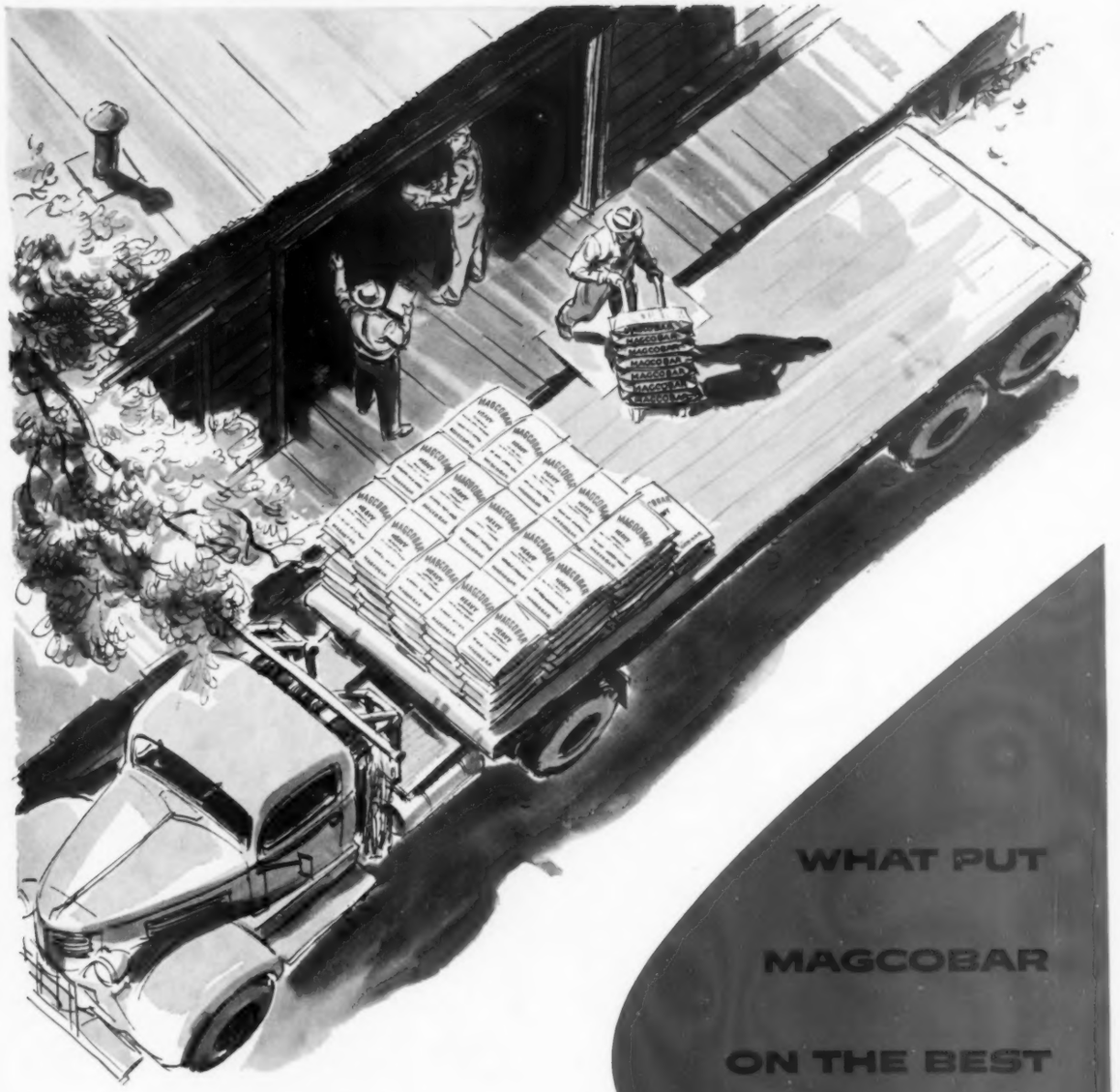
..only part of the picture

OIL REFINERY ENGINEERS know that Newalls bring more than materials to the site, because they realise that even first class insulation materials cannot do justice to themselves unless they are efficiently applied. In fact, the task of planning that the right materials are used is a job studied carefully by Newalls before their recommendations are submitted. Through consultation with Newalls you can make very certain that method as well as materials is brought to bear on the problem. That's maybe why Newalls record of refinery insulation jobs makes such an impressive picture.

Where there's a HEAT INSULATION problem

there's a job for **Newalls**

NEWALLS INSULATION CO. LTD. *Head Office*, Washington, Co. Durham. *A member of the* TURNER & NEWALL ORGANISATION
Offices and Depots at LONDON, GLASGOW, MANCHESTER, NEWCASTLE UPON TYNE,
BIRMINGHAM, BELFAST, BRISTOL & CARDIFF. *Agents and Vendors in most markets abroad*



WHAT PUT MAGCOBAR ON THE BEST SELLER LIST?

There is only one answer when products for the oil industry consistently gain wider and wider use and acceptance year after year. The answer is: outstanding performance, day after day under any and all circumstances.

Magcobar has been built on a solid foundation of highest quality products, good service and fair and reasonable prices. With faith in its record, Magcobar has continually reinvested a major portion of its income in additional facilities to serve the oil industry. When you need drilling mud products today, you can be sure of the quality when it's in a Magcobar bag.

Magcobar

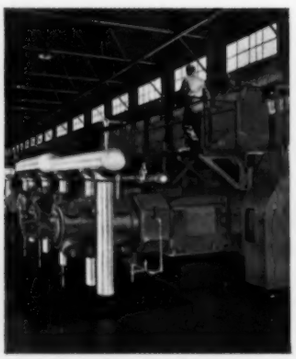
MAGNET COVE BARIUM CORPORATION
HOUSTON, TEXAS
ONE OF THE DRESSER INDUSTRIES

KOBE

IS ONE OF THE DRESSER INDUSTRIES

An important member of the family of Dresser Industries since 1945, Kobe Inc. Division of Dresser Equipment Co., of Huntington Park, California, today plays a vital role in reducing operating costs for oil producers everywhere. Kobe's hydraulic oil well pumping system, featuring the famous Free Pump, has revolutionized production techniques with resultant savings on labor and equipment costs.

MAGNET COVE BARIUM CORP., Houston, Tex., Malvern, Ark. Magcobar drilling mud, Magcogel bentonite, Mylojel, Fiber Seal, Jel-Oil mud.



CLARK BROS. CO. DIVISION, Olean, New York. Engines and compressors—gas, steam and diesel driven.

DRESSER MANUFACTURING DIVISION, Bradford, Pa. Oil and gas pipe couplings, fittings and sleeves—rolled and welded rings—welded fittings and flanges.

KOBE, INC., DIVISION, Huntington Park, Calif. Complete hydraulic oil field pumping systems, including the Kobe Free Pump.

No. 6 in a series about Dresser Industries

What is the DRESSER plus+?

The Dresser Plus is the extra *service* you get when you deal with any Dresser company. It is an added advantage for you which stems from Dresser's unique overall organization. For Dresser is many companies with a single purpose—to provide the growing oil and gas industries with operating equipment that is *second to none*.

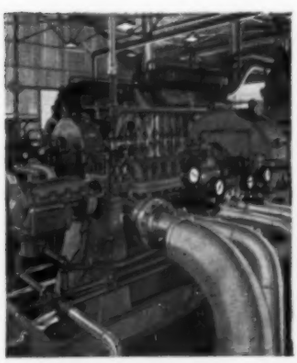
Each company in the Dresser group functions independently within its own specialized field—yet each can draw from the total resources, in manpower, research, and know-how, of the combined Dresser operations. When you work with any of the Dresser companies, all of the facilities of Dresser are *at your service*.

Planned, coordinated specialization—company by company—"one for all and all for one"—that is the DRESSER PLUS +

Kobe's Free Pump, adapted from the original hydraulic pumping system, hydraulically "runs" and "pulls" the bottom hole pump, allowing pumper to handle pump changes without service crews or equipment required by other pumping methods. The advantages due to operating and installation cost savings are further amplified by many extra features which include positive paraffin control, easy and quick bottom hole pressure surveys and wide-range well regulation.

DRESSER INDUSTRIES, INC.
OIL, GAS AND CHEMICAL EQUIPMENT

ATLANTIC BUILDING ★ DALLAS, TEXAS



PACIFIC PUMPS, INC., Huntington Park, Calif. Centrifugal pumps, deep oilwell plunger pumps, hot oil and boiler feed pumps.

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind. Rotary positive blowers, gas pumps, centrifugal blowers, exhausters; positive displacement meters.

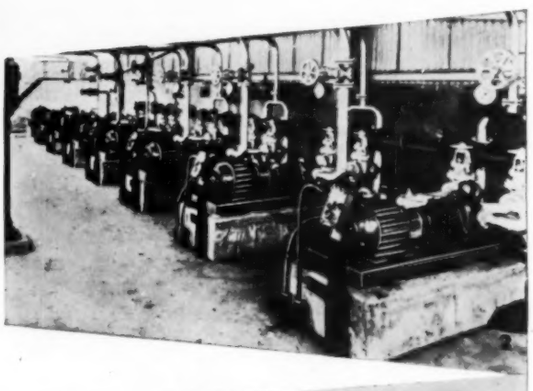
SECURITY ENGINEERING DIVISION, Whittier, Calif., Dallas, Tex. Rock bits, reamers, casing scrapers, reamer rock bits, coring bits, Securaloy.

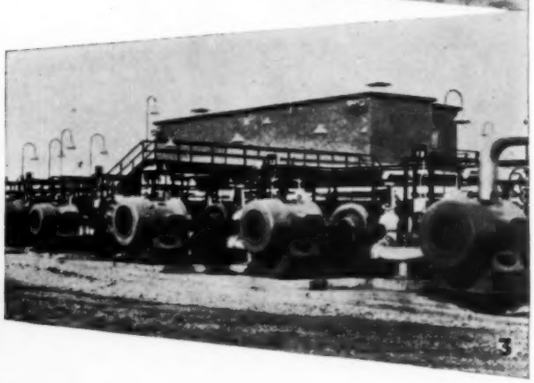
IDECO DIVISION, Dallas, Beaumont, Tex. Derricks, drawworks, rambler drilling rigs, traveling blocks, rotary tables.

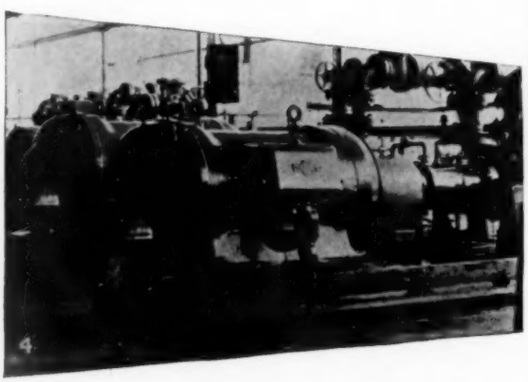
FLAMEPROOF MOTORS certified for group 2 and group 3 gases

A complete range of Metrovick Buxton-certified flameproof motors is available for refineries and petro-chemical works, for either indoor or outdoor use. Machines with either ball and roller bearings, or sleeve bearings, can be supplied, and all are suitable for hot product pumps.

A specialised range of splash-proof well-pump motors and industrial type machines for non-hazardous locations is also available.







1. *A range of flameproof motors in one of the main pumping stations at Scottish Oils, Grangemouth Refinery.* 2. *Type KFB flameproof motors driving Sigmund pumps at Shell Stanlow Refinery.* 3. *300-600 hp outdoor flameproof motors at the product loading station at Esso Refinery, Fawley.* 4. *125 hp 3500 rpm T.E.F.C. motors driving oil pumps at Trinidad Leaseholds Pointe-a-Pierre Refinery, British West Indies.*

METROPOLITAN-VICKERS ELECTRICAL COMPANY LIMITED
Member of the A.E.I. group of companies
TRAFFORD PARK · MANCHESTER, 17

METROVICK *Motors Serve the Oil Industry*

CATFORMING *means*

SIMPLICITY

for high octanes and high yields at low cost

Simplicity is the keystone of Catforming. Why? Because simplicity takes the high cost out of high octanes and high yields.

Simplicity speeds construction of Atlantic Catforming units—saving you money and time.

Simplicity makes operation of these units easy—saving you money on operating costs and manpower as well.

Simplicity means efficiency — Catforming cuts out intermediate steps in processing feed stocks, gives you high octane gasoline ready for immediate blending—and distribution.

Simplicity goes all the way with Catforming, including the licensing agreement—you'll find it well worth looking into. Remember, the performance of Catforming units has been proved in highly successful commercial operations in many areas. Write, wire or phone for detailed information — ask for our brochure, "CATFORMING." The Atlantic Refining Company, Research and Development Dept., P. O. Box 8138, Philadelphia 1, Pa.

ATLANTIC *It's the Catalyst that counts*

ANOTHER NEW foam DEVELOPMENT...

the Pyrene TRADE MARK Spray/Jet

FOAM-MAKING BRANCHPIPE

(PATENT APPLIED FOR)

This new Foam-making Branchpipe enables foam to be discharged in the form of a jet or a spray, at will, according to the fire conditions. The long-striking jet projected by this appliance is similar to that given by the normal F.B. 10 "Pyrene" Foam-making Branchpipe with taper nozzle. A simple movement of a control handle at the end of this new branchpipe converts the jet into a spray extending for about 30 feet. The foam spray is extremely useful for dealing with fires in confined spaces and for outbreaks such as those involving a film of oil or other highly inflammable liquids. The spray also provides an appreciable amount of heat insulation for the operator. Although the illustrations show the use of a pick-up tube for foam compound, the "Pyrene" SPRAY/JET foam-making branchpipe can be used in conjunction with inline or multiple-jet inductors.

ALREADY IN USE IN GREAT BRITAIN AND OVERSEAS

Full particulars of this new foam equipment will be forwarded on application. Please write to Dept. W.P.4.

THE PYRENE COMPANY LIMITED

9, GROSVENOR GARDENS, LONDON, S.W.1. ENGLAND. Cables: "Pyrene London"

KNOWLEDGE
a power for good

The Standard-Vacuum organization is continually expanding its educational and training programs for its 40,000 employees in the various areas where it operates.

In Indonesia, for example, 71 formal training courses as well as on-the-job instruction are giving several thousand men new skills . . . teaching them to work as a team and to produce more . . . improving their ability to shoulder responsibility . . . adding to their economic security as individuals and their economic strength as citizens.

Stanvac seeks to do its part in developing the capacities of its employees so that they become better qualified to carry on the company's operations and to participate in supervisory and administrative functions.

Greater knowledge is truly a power for good.

STANDARD-VACUUM OIL COMPANY

A name that stands for "Progress" in the East

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NEWTON CHAMBERS

for

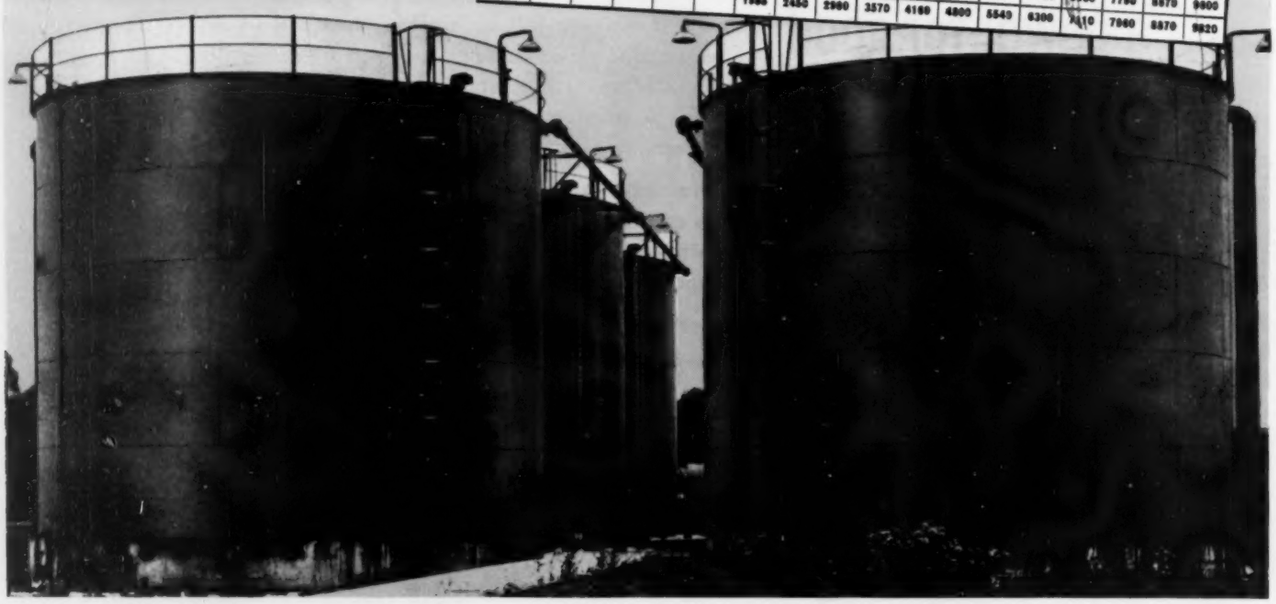
MILD STEEL

STORAGE TANKS

CAPACITIES IN TONS OF MILD STEEL STANDARDISED TANKS

APPROXIMATELY CORRECT FOR EITHER WATER OR OIL

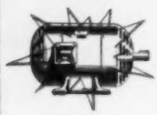
Depth in Feet.	DIAMETER OF TANK IN FEET.															
	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
16	140	216	317	430	560												
17	148	230	337	468	598												
18	157	244	357	484	630	800											
19	166	257	377	510	665	845	1030										
20	175	271	397	538	700	889	1085	1320	1580	1850	2140	2460	2800	3170			
21	184	286	417	564	735	934	1140	1380	1660	1940	2260	2580	2940	3320			
22	193	300	437	591	770	978	1195	1455	1740	2030	2350	2700	3080	3480			
23	201	313	457	617	806	1020	1250	1520	1820	2120	2460	2830	3220	3640			
24	210	327	478	644	840	1066	1305	1590	1900	2220	2560	2955	3380	3800			
25	218	340	496	672	875	1110	1360	1655	1980	2310	2670	3075	3500	3980	4420	4920	5450
26		354	516	697	910	1150	1420	1720	2060	2410	2770	3200	3640	4110	4600	5120	5670
27		367	536	726	945	1195	1470	1785	2140	2500	2880	3320	3780	4260	4780	5320	5890
28		381	556	751	980	1240	1525	1850	2220	2590	2990	3440	3920	4430	4955	5520	6110
29		395	576	778	1015	1285	1580	1920	2290	2680	3090	3570	4060	4580	5140	5710	6330
30		408	596	804	1050	1330	1635	1985	2375	2780	3200	3680	4200	4750	5300	5910	6540
31			616	831	1085	1375	1690	2050	2450	2870	3310	3820	4340	4900	5480	6110	6760
32			635	858	1120	1415	1745	2120	2530	2980	3410	3940	4480	5050	5660	6310	6985
33			655	885	1155	1460	1800	2180	2610	3050	3520	4080	4620	5220	5840	6500	7200
34			675	912	1190	1505	1855	2250	2690	3140	3630	4180	4760	5380	6020	6700	7420
35			695	940	1225	1550	1910	2315	2770	3240	3730	4300	4910	5540	6200	6900	7640
36				966	1260	1595	1980	2380	2850	3330	3840	4430	5050	5690	6360	7100	7850
37				991	1295	1640	2020	2450	2930	3420	3940	4560	5190	5850	6550	7290	8070
38				1018	1330	1680	2070	2510	3010	3510	4050	4670	5340	6000	6720	7480	8280
39				1045	1365	1725	2125	2580	3080	3600	4150	4800	5470	6160	6903	7690	8500
40				1072	1400	1770	2180	2645	3170	3700	4260	4930	5610	6320	7170	7890	8730
41						1815	2240	2710	3240	3790	4380	5050	5750	6480	7250	8080	8950
42						1860	2290	2780	3329	3890	4470	5160	5880	6640	7430	8250	9160
43						1905	2345	2840	3400	3980	4570	5290	6020	6800	7600	8480	9380
44						1950	2400	2910	3490	4070	4690	5410	6160	6960	7780	8670	9605
45						1996	2450	2980	3570	4160	4800	5540	6300	7110	7960	8870	9820



NEWTON CHAMBERS & Co. Ltd., THORNCLIFFE, Nr. SHEFFIELD

LONDON OFFICE: GRAND BUILDINGS, TRAFALGAR SQ., LONDON, W.C.2

The motor that *smothers explosions!*



You can't stop a motor from throwing sparks . . . and if there's petroleum vapor around you can't prevent the ensuing explosion. But you can make sure such explosions cause no damage —by replacing outmoded motors with Westinghouse Explosion-Proof motors wherever petroleum fumes collect. These totally enclosed, fan-cooled motors smother explosions *inside* the motor, where they do no harm.

There's no secret about how this is accomplished. Closely machined fits are designed to keep any internal flame or spark from reaching the outside of the motor. That's why you can count on Westinghouse Explosion-Proof motors to deliver *safe* as well as *dependable* performance on pumps, compressors and other constant speed equipment in drilling, pumping, pipe line and refinery operations.

Add to this important safety feature the rugged, compact construction of Explosion-Proof motors—heavy steel or cast iron frame, feet and end brackets for maximum strength and rigidity . . . long resistance to corrosive atmospheres. Exclusive "Tuffernell" insulation and wire covering of synthetic resin provide high dielectric strength and long life. For more information about Explosion-Proof motors write to Dept. U, Westinghouse Electric International Co.

For safe operation *in explosive atmospheres, Westinghouse Explosion-Proof motors are furnished with characteristics suitable for a variety of applications. One to two hundred horsepower; 2 and 3 phase; 60, 50, 25 cycles; 208, 220, 380, 440 and 550 volts. Special voltages available on order.*

YOU CAN BE **SURE** ...IF IT'S

Westinghouse

WESTINGHOUSE ELECTRIC INTERNATIONAL COMPANY
40 Wall Street, New York 5, U. S. A.

Seal in All Your Horsepower!

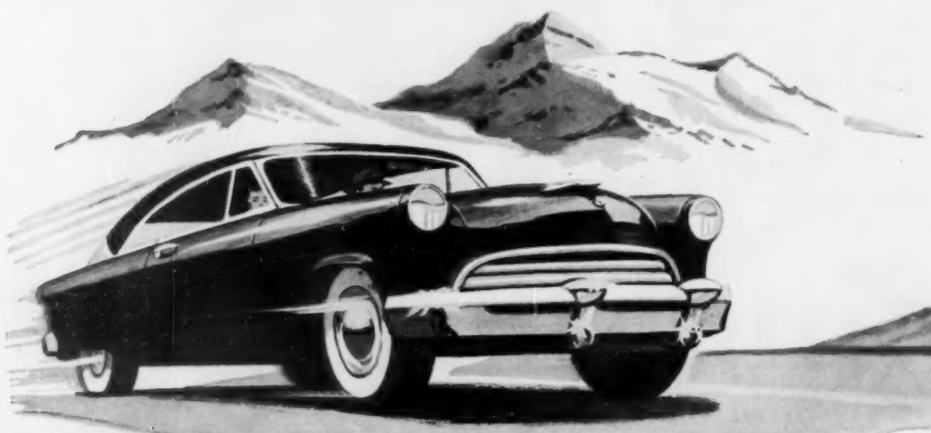
with the Veedol Motor Oil

"Film of Protection"

Use all the horsepower built into your powerful engine! Seal *in* the great performance your car can give . . . with the world-famous VEEDOL "Film of Protection."

VEEDOL Motor Oil forms a protective anti-corrosion film on metal surfaces . . . helps keep soot, contaminants and gasoline out of your crankcase . . . fights the ravages of acid "engine sweat." So . . .

Don't waste horsepower! Use all the power your car can deliver. Change to VEEDOL Motor Oil . . . today!



TYDOL

TIDE WATER ASSOCIATED OIL COMPANY
New York Tulsa San Francisco

FEDERAL TIRES
Federal Flying -A- Tires . . .
Good for a long safe ride!

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Fractions
SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95′7″ crude tower shown in the photograph, ready for shipment, is a representative example.

Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America.

Sun

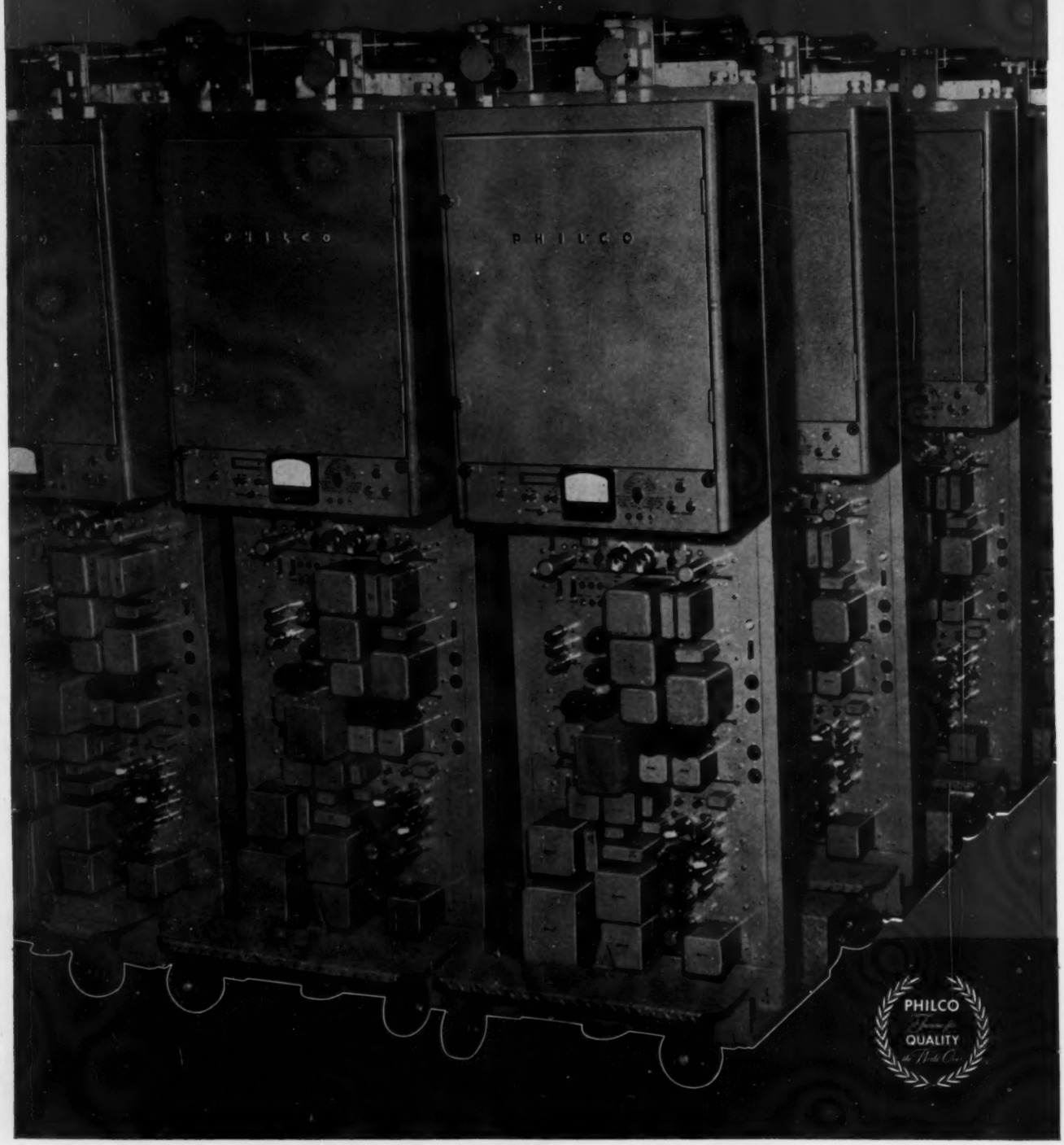
SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE (SINCE 1916) CHESTER, PA.

25 BROADWAY • NEW YORK CITY

PHILCO...

...HAS BUILT AND SHIPPED OVER



1000 MICROWAVE EQUIPMENTS

More than ALL OTHER Manufacturers Combined!

As the world's leading supplier of microwave, Philco has manufactured and delivered nearly 1400 complete microwave equipments...enough to span the nation five times—*or to privately link New York and Hong Kong!* Philco has built and shipped more microwave systems than all other manufacturers combined.

Philco has the distinct advantage of a world-wide installation and service organization, and an experienced system-planning department. These valuable facilities enable Philco to obtain first-hand information on the operation of existing installations, improve equipment, and thus supply new microwave systems which assure the greatest economy and dependability in performance.

This is one reason why Philco microwave is the preference of industry—*good reason why Philco is the world's leading manufacturer of microwave equipment.*

Need a speedy and permanent cure for those communication headaches? Then consider microwave . . . and when you do, specify Philco. An experienced Philco representative is ready to serve you.

World's Leading Manufacturer of Microwave Equipment!

For complete details, write to Dept. WP today

PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION PHILADELPHIA 44, PA.

ANOTHER IMPORTANT CONTRIBUTION TO PETROLEUM PROGRESS

Unifi

A New Catalytic Refining Process to Purify Petroleum Distillates

Universal Oil Products Company is pleased to announce that the UNIFINING process is now available to the petroleum refining industry, and a refiner may secure the benefits of the combined techniques and patent rights of both Universal Oil Products Company and Union Oil Company of California through a single licensing arrangement.

The process uses a cobalt-molybdenum type catalyst to react hydrogen with petroleum distillates, saturating the olefinic hydrocarbons and removing sulfur, nitrogen, oxygen, and other impurities to the degree desired by the refiner.

Excess hydrogen from a UOP Platformer provides an excellent and economical source of hydrogen for the Unifining unit.

n i n g

Unifining is particularly advantageous for pretreating certain types of feed stocks prior to processing in a UOP Platformer. By using Unifining in combination with a Platforming unit, the refiner will find that engineering advantages accrue which will be reflected in lower costs to him.

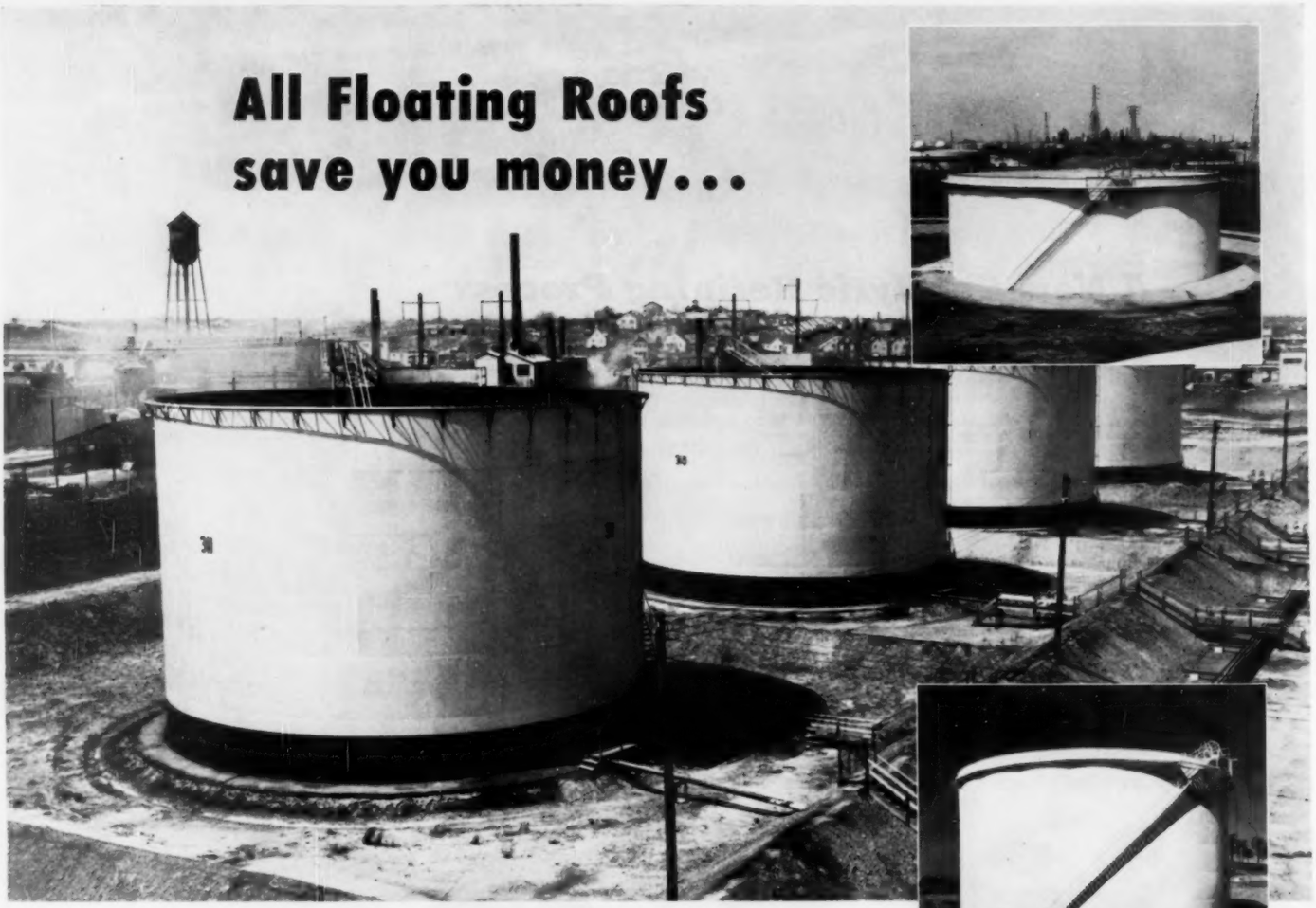
UNIVERSAL OIL PRODUCTS COMPANY

General Offices: 30 ALGONQUIN ROAD, DES PLAINES, ILL., U.S.A.

Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment

All Floating Roofs save you money...



FIND OUT HOW A

Wiggins Floating Roof

CAN SAVE MORE MONEY FOR YOU
CAN GIVE YOU BETTER OPERATION

Important savings—and all savings that help to improve profits are important—can only come about by doing a specific job better. The performance of the Wiggins Floating Roof has been analyzed and compared with all other types throughout the world in every range of temperature and climate.

It is a proven fact that the Wiggins Triple Seal is a major factor enabling Wiggins Roofs to save more of the volatile vapors—meaning profit—than can any other type. Thus a Wiggins installation "pays out" more quickly.

That's not all; the Wiggins designs take into account those matters of conservation, safety and maintenance so thoroughly that when you have a Wiggins Floating Roof you have one that sets a new, high standard of performance—and in investment, too.

Maybe not today, or tomorrow . . . but *soon* you may decide to modernize by the installation of the finest money-saving equipment available.

However, *now* is the time to write for important technical data comparing Wiggins Floating Roof, feature for feature, result for result, with all other roofs. We can prove that Wiggins Floating Roofs do the best job, the most profitable job, under all conditions.

EXPORT DIVISION
GENERAL AMERICAN
TRADE MARK

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Sydney, Australia

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Comercio e Industria de Ferro S.A.
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Rio de Janeiro, Brazil

Tsukishima Kikai Company Ltd.
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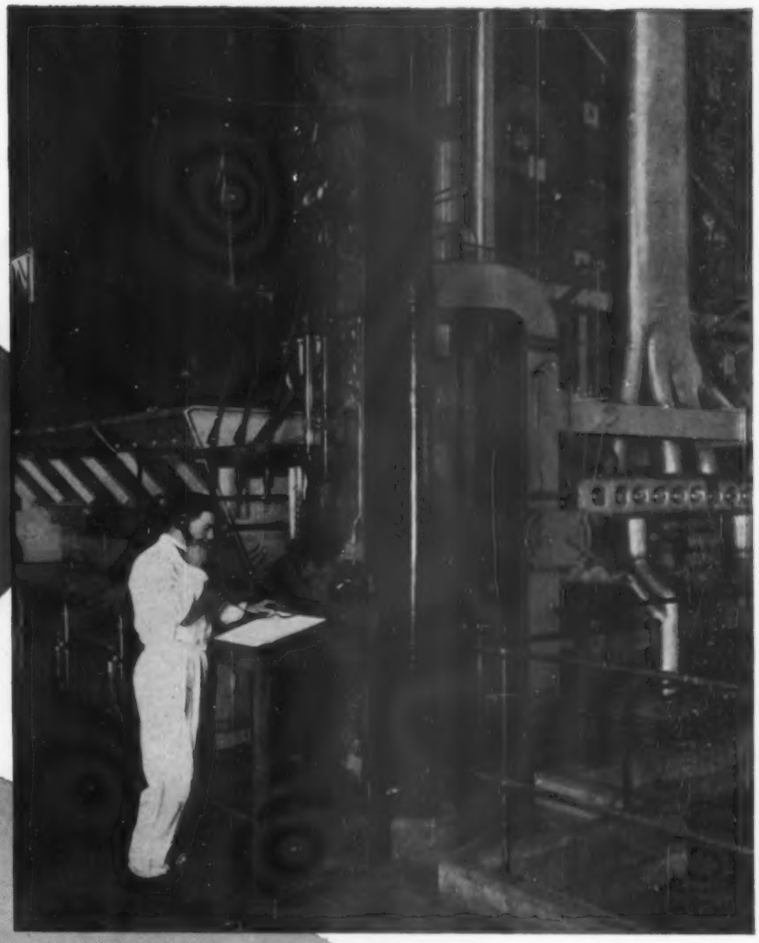
Tokyo, Japan

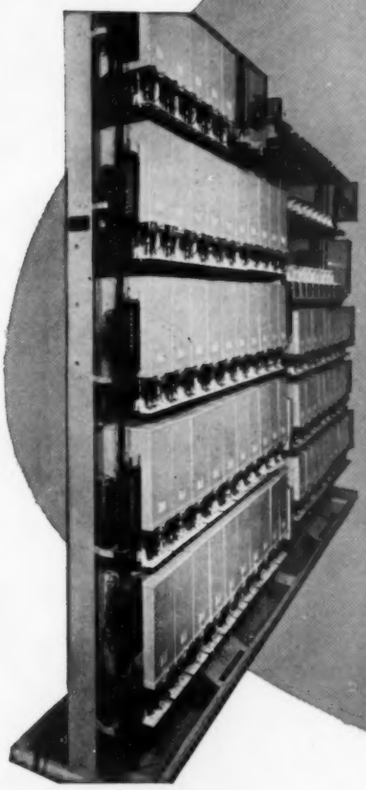
Toronto Iron Works Ltd.
629 Eastern Avenue
Toronto, Ont., Canada

GENERAL AMERICAN TRANSPORTATION CORPORATION

Export Division: 380 Madison Avenue, New York 17, New York

Efficiency Additive





The new plant of the Associated Ethyl Company Limited at Ellesmere Port, Cheshire, England, is equipped with a 300-line private automatic exchange supplied by Communication Systems Ltd.* Besides normal point-to-point communication, essential for co-ordinating the production activities of this great undertaking, the exchange equipment caters for a number of special features the most important of which is the provision of telephone service in certain zones where gaseous products may be present in inflammable quantities. 25 special telephones with associated couplers and repeaters form an approved safe system for these areas and yet at the same time are part of the dialling network. An additional 12 telephones are fully tropicalized and fitted with platinum contacts for use in chlorinated atmospheres. The whole exchange is designed to operate continuously and on a completely unattended basis.

** Marketing organisation in the United Kingdom for "A.T.M." private telephone systems.*

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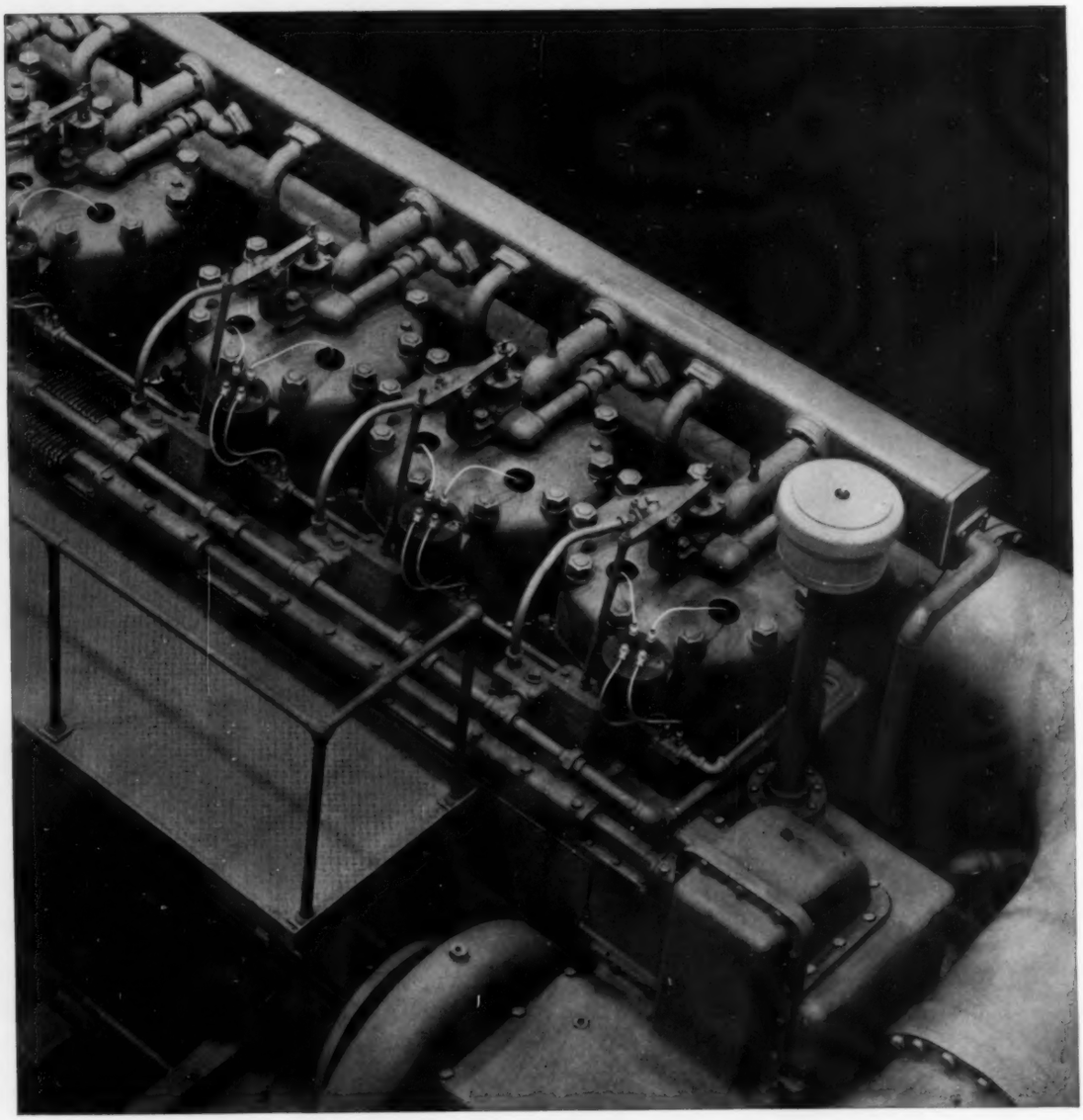

...a distinguishing feature of Clark Turbocharged Compressors

Don't take our word for it. Look at the picture. Look at the parts that *aren't* there! Simplicity — in a word — best describes the Clark Turbocharged 2-Cycle design.

Exhaust valves? Scavenging cylinders? You won't find them. There aren't any.

Everything is out in the open. With the Clark inline design, *nothing* is buried under a maze of "hot" parts.

But, this Clark simplicity is not just skin-deep. It applies to the inside as well. There are no lost motions. To develop maximum power, every down stroke of the pistons is a power stroke. Actually, the number of moving parts is practically cut in *half*.

Best of all, to match the inherent simplicity of *all* Clark 2-cycle compressors, turbo-charging has been applied in such a simple, foolproof manner that the operator can forget it's there.

Burning less fuel, requiring less cooling water and developing more power per cubic inch of piston displacement than any gas-engine-driven compressor in the world, Clark Turbocharged Compressors *defy* comparison.

For complete information on Models TRA and TLA, in sizes ranging from 825-3300 bhp, see your Clark representative. Request Bulletin 130.

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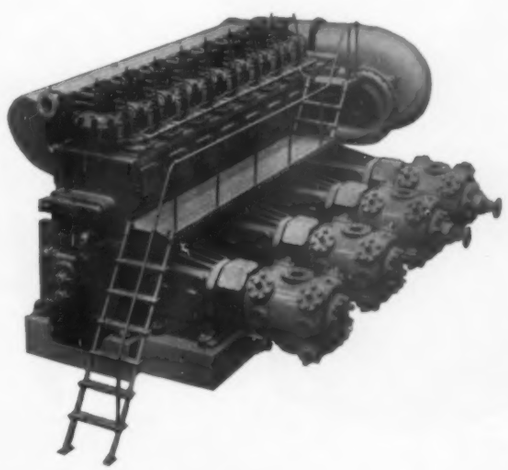

Clark sets the pace in compressor progress

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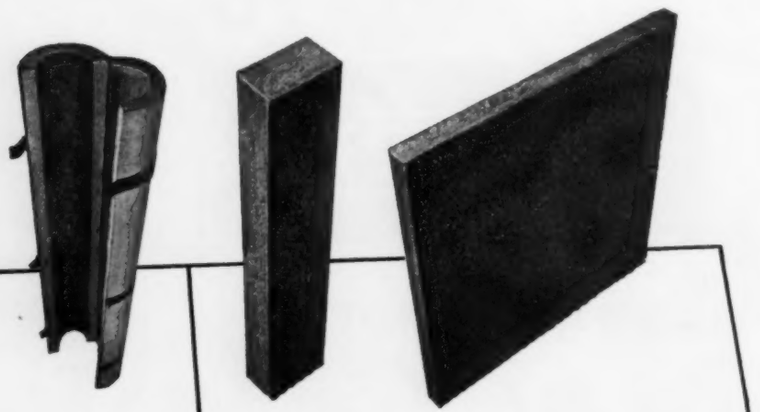
CAPOSITE insulation is not just all-asbestos. It is *all-amosite;* amosite being the uniquely long-fibred asbestos—from the Cape Asbestos Co. Ltd's own mines—which makes possible CAPOSITE'S particularly open, cellular texture. This texture gives it a level of thermal insulation which saves over 98 per cent. of uncovered hot surface losses, plus a resistance to the severest conditions of steam heat which enables it to maintain this efficiency almost indefinitely. CAPOSITE pre-formed pipe-sections and slabs are extremely strong, yet light and easy to fit; non-corrosive; and exceptionally economical. Write for full details.



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PETROLEUM CHEMICALS DIVISION

NEWS

DU PONT REG. U.S. PAT. OFF.

April ★ One of a Series of Interest to the Petroleum Industry ★ 1954

100 BARRELS
of better public understanding

"By-the-barrel" is an unusual way to measure public relations. But we think it's appropriate in the case of the Du Pont *Magic Barrel* presentation.

So far 100 of these intriguing demonstrations have been put to work in the public relations programs of numerous oil companies and by the OIIC.

The *Magic Barrel* was developed by the Du Pont Petroleum Chemicals Division to help the oil industry explain the tremendous and growing importance of petroleum to our national economy.

The 100 barrels now in use have been featured in more than 1000 public presentations and in 29 TV shows to an estimated total audience of around 5 million people. Its reception by the general public has been overwhelmingly favorable.

Du Pont Aviation Mix Now Available with Lower Blue Dye Concentration

Color specifications for military aviation gasoline have recently been revised. To make it easier for refiners to meet the new color standards, Du Pont Tetraethyl Lead Compound — Aviation Mix — is now being made with a lower concentration of blue dye.

In the new Aviation Mix, the dye concentration is sufficient so that there is no need for suppliers of military aviation gasoline to add additional Oil Blue A when a minimum of 4 cc. of TEL is used per gallon of gasoline. In this proportion, the new mix provides a safety margin of 4% above the minimum color specifications. And when 4.6 cc. of the mix per gallon of gasoline are added, the margin of safety is increased to 20%.

Until recently, color standards furnished to refiners were solutions of oil soluble dyes in iso-octane, and were subject to fading on exposure to sunlight. New color standards, with improved light stability, have been developed through the cooperative effort of the U. S. Air Force and the Du Pont Petroleum Chemicals Division.

These standards will assist refiners in meeting the new color specifications and may be obtained by following the procedures outlined in specification MIL-F-5572.

Du Pont Marketing Services Tailored to Fit YOUR OWN Promotions

Du Pont's Petroleum Chemicals Division has developed a wide range of marketing aids and services to meet the needs of the petroleum industry.

Here are some of the ideas which are helping many oil companies get extra mileage out of their present programs:

Enhancing the selling power of your own brand name is the over-all objective of the Du Pont marketing services program.

Suppose, for example, you have built up a reputation for the heavy-duty, long-lasting features of your motor oil. You have done such a good job of selling the motoring public on these qualities that they tend to minimize the need for frequent oil changes.

How can your dealers sell the need for oil change at regular intervals — without detracting from the quality features of your motor oil?

"... dirtied to death"

To help you overcome this problem, Du Pont developed a visual aid presentation which can be used at meetings to give dealers just the information they need. Its theme is: "Good oil seldom wears out . . . but it can become dirtied to death."

Your Greatest Asset

To help you capitalize the selling power of your name, the Du Pont Brand Name Program (suitable for larger oil companies) has provided another unique visual aid presentation. Specially designed to fit individual gasoline quality features and company marketing problems, it has proved useful for building dealer loyalty and supplying information that helps sell.

Demonstrate On-the-road Performance

Where could you find a more convincing tool for demonstrating how your

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OVER

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Marketing Services*

products perform on the road than with a specially equipped and instrumented test car?

Several of the cars in the Du Pont Fuel Test Fleet can be made available to you for this purpose—on a special arrangement basis. These cars are an ideal aid in contacting large fleet customers. And when equipped with Du Pont supplied portable chassis dynamometers, the cars are useful for dealer meeting demonstrations.

Use of the Du Pont fleet of road test cars offers a unique and convincing approach to selling big fleet customers.

When the Customer Complains . . .

Your dealers need a ready, salesmanlike answer whenever they get a customer complaint about knock, poor mileage, poor starting, etc.

Whatever your merchandising program, its success generally depends on your dealers. The majority of Du Pont marketing services are, therefore, designed to help you sharpen dealer sales techniques.

To help them handle such situations, Du Pont has prepared folders that answer the most common customer complaints. Illustrated with cartoons, these pocket-size folders are written in a direct style, easy to understand and to remember.

Get the Facts

A wealth of information on how your customers buy has been made available to you through Du Pont.

The Du Pont Consumer Gasoline Buying Habits Survey—based on thousands of interviews and service station observations throughout the country—documents the motoring public's habits and preferences in buying gasoline, motor oil and TBA products. Dealer services are covered, too. This information has proved a valuable aid in planning advertising and merchandising programs.

Broad Program

These are only a few of the many helpful marketing services furnished by Du Pont. The others include a movie lending library of films of significance to the petroleum industry, a quarterly nationwide survey of competitive octane ratings, a speaker service for dealer meetings and various oil industry public relations aids.

If you are not taking full advantage of these services, be sure to contact a Du Pont Petroleum Chemicals Division representative or one of the regional offices for details.

New District Manager Named

With expanding operations in the Du Pont Petroleum Chemicals Division's Eastern Region, a district office has been created in Pittsburgh.

Afton D. Puckett, who has been serving the Pittsburgh area as a sales-service representative for the past two years, has been named manager of the Pittsburgh district.

Previous to his first assignment in the Western Pennsylvania area, Mr. Puckett was coordinator of operations of the five district laboratories of the Du Pont Petroleum Chemicals Division. In this capacity, he also supervised technical work connected with the quarterly Motor Gasoline Survey.

Mr. Puckett joined the Du Pont Company in 1947. He was at that time put in charge of studies on antiknock properties of motor fuels at the Du Pont Combustion Engineering Laboratory. After receiving a chemical engineering degree from Oklahoma A & M College in 1936, he became an engineer for the Tide Water Associated Oil Company. From 1941 to 1946 he served as fuels chemist and petroleum engineer with the National Bureau of Standards. He then worked on diesel fuel problems at the U. S. Bureau of Mines Petroleum Experiment Station at Bartlesville, Oklahoma.

AFTON D. PUCKETT

Mr. Puckett is the author of several technical papers on combustion characteristics of motor and diesel fuels.

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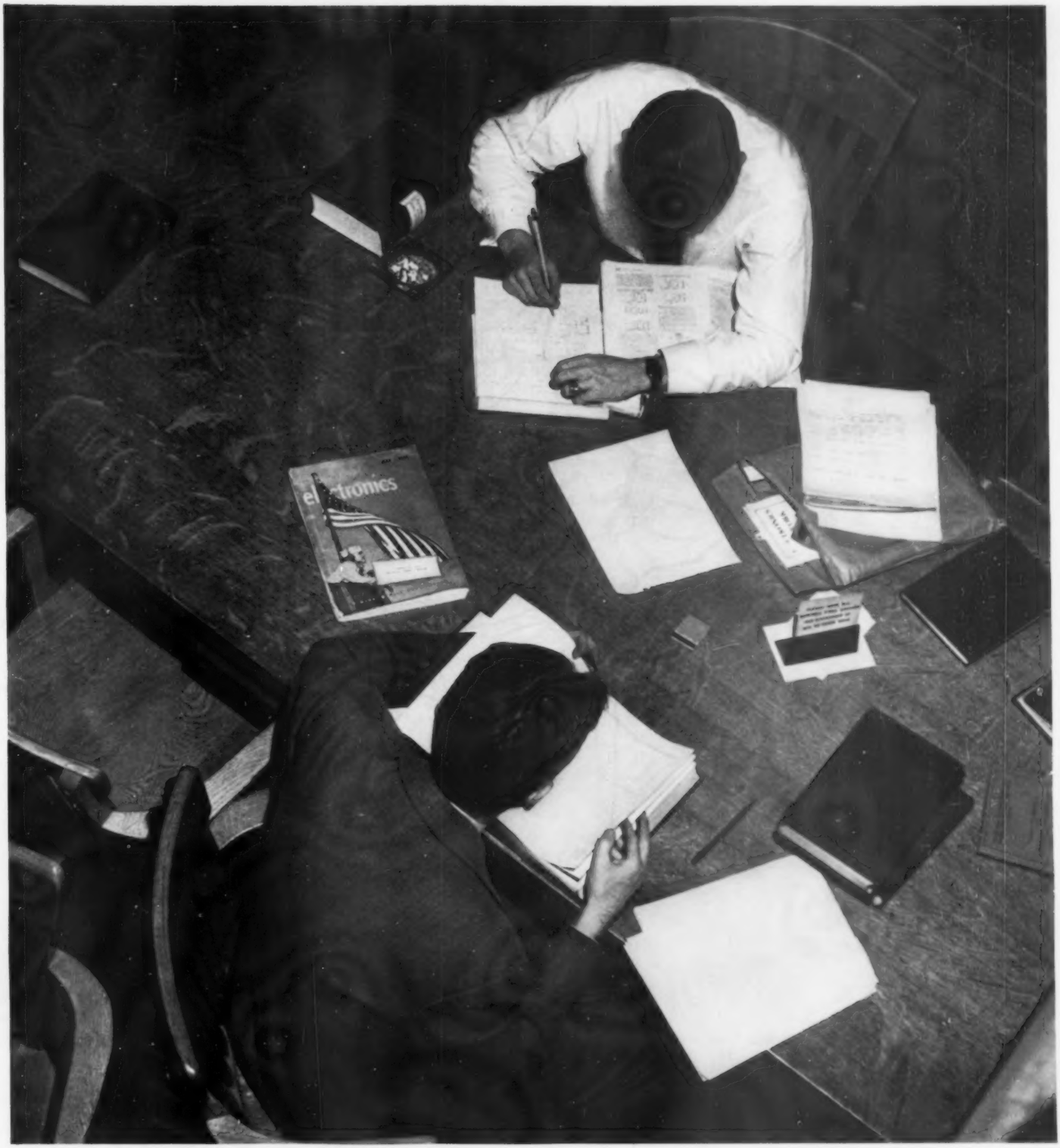

"Education, more and better education, is needed if we are to maintain that most cherished of man's works—a free society. More than ever before, men today need to know how to think; to weigh and appraise; to achieve the steadiness of vision and purpose that wisdom brings."

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IT'S PLAIN GOOD SENSE...

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EXPERIENCED FIELD CONSTRUCTION STAFFS

Results at R.J.'s new Platformer show advantages of CONSTRUCTION BY PROCON

Throughout the petroleum refining industry, Procon has established an enviable record for getting processing units on stream faster, more efficiently and more economically.

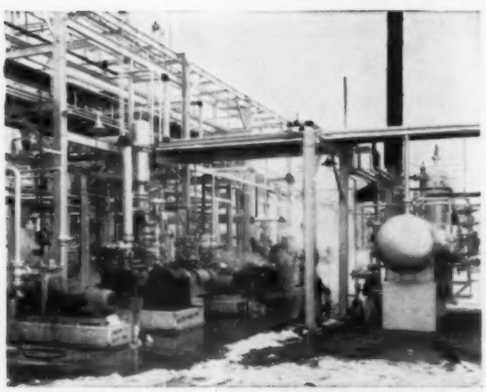
A good example is the 600 B/SD UOP Platforming unit constructed at the Princeton, Ind. refinery of the R. J. Oil and Refining Company, Inc.

One of the reasons why Procon built this unit with maximum speed and efficiency is that it implemented its "off-the-shelf" designs with construction service based on its wide experience gained from previous construction of UOP Platformers.

Any other refiner, like R. J., can benefit by choosing from this unusual stockpile of knowledge and designs the exact type of unit best suited to his particular needs.

Procon has available complete designs for UOP Platforming units ranging from 600 B/SD to 16,000 B/SD—"off-the-shelf" construction that means vital savings in time and costs.

IT'S PLAIN GOOD SENSE for any refiner to choose Procon when he wants the ultimate in ANY type of process construction.



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ITALY—Caltex fuels and lubricants are marketed in Italy by our friends and affiliates, Petrolcaltex. Modern service stations like this one, distinguished by the famous banjo sign, offer motorists, truck and fleet operators the finest in automotive products and service.

AUSTRALIA — This progressive land is justly proud of sleek new Diesels that are making railroad history "down under." Caltex is proud too, because every Diesel locomotive operating in Australia is lubricated with Caltex products. The conversion to Diesel means better freight and passenger service . . . "more power to Australia!"

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In 67 lands, across half the world, through such developments as these, Caltex is able to supply better fuels and lubricants for industry, for agriculture, and for motoring millions. These require a continual investment of funds and skills, backed by a faith in a better future for free nations.

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CALTEX Petroleum Products

SERVING EUROPE • AFRICA • ASIA • AUSTRALASIA

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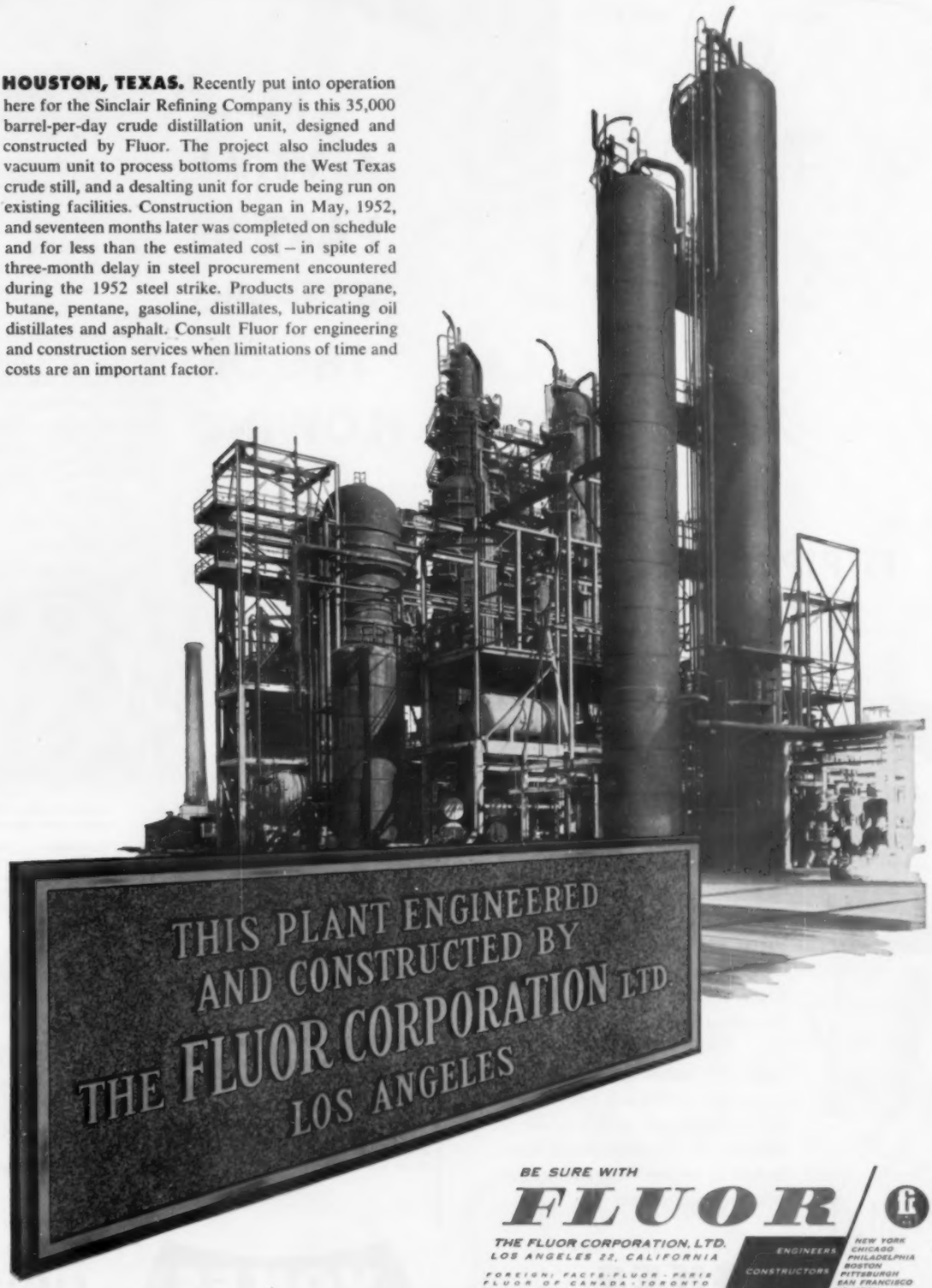

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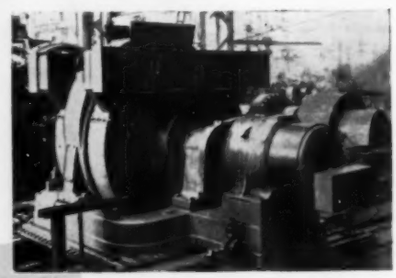

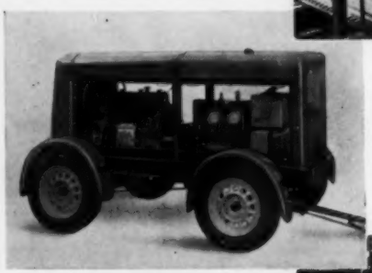

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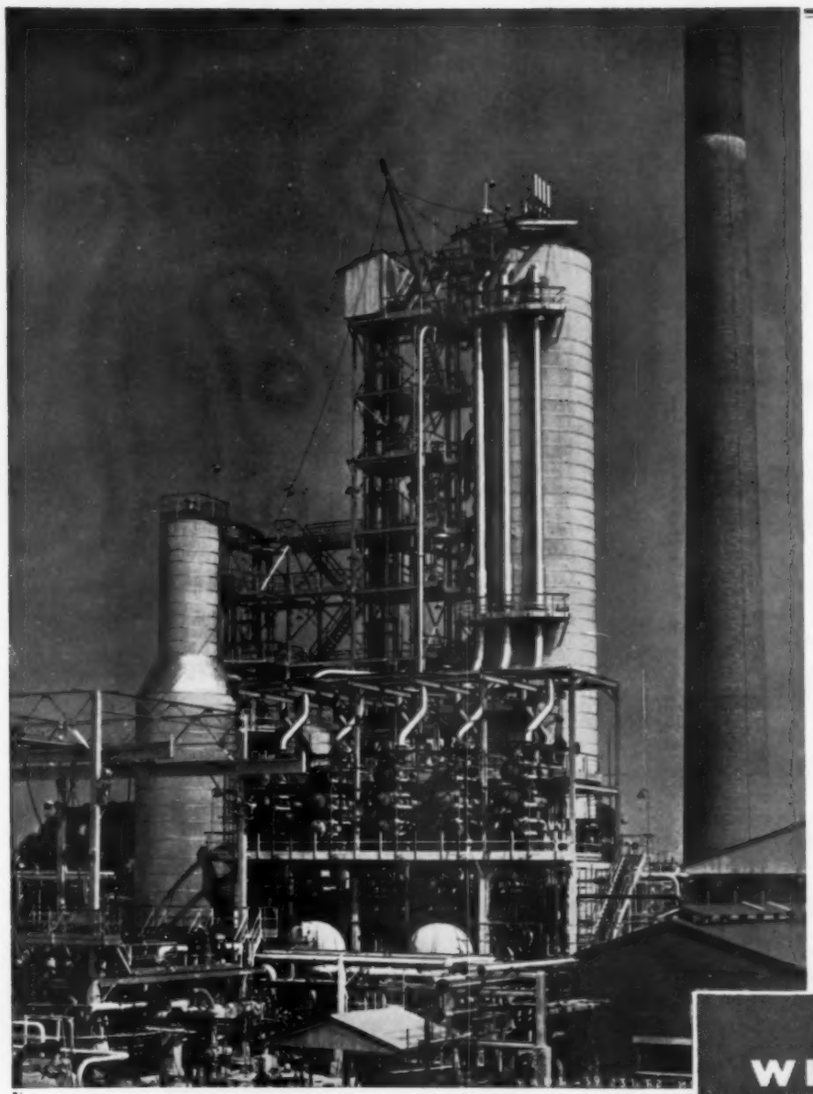

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(Tel. 8-4179)

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4058 Crenshaw Blvd.
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Sales Representatives:
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THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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THIS MONTH'S COVER

Cover photograph is of cracker built by Fluor Corporation for Socony-Vacuum's Paulsboro, New Jersey refinery. Photographer was Elwood Payne.

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Oil for Today—and for Tomorrow

AN interesting monograph which should be brought to the attention of the broadest possible audience in the United States has just been published under the above title by the Interstate Oil Compact Commission. It is part of the educational campaign of the Commission to familiarize the general public with essential facts on oil, the conditions under which the oil industry operates, and its relation to the nation's total economy.

The 84 pages of this booklet are filled with a series of articles, graphically illustrated, and written by authorities on various phases of the oil industry, but couched in simple and readily understandable terms. It is not intended, of course, for those who are conversant with the production and processing of oil, but is devised "for the presentation in condensed form of important aspects of production and conservation in a way that laymen such as legislators and students can easily understand."

The reference to legislators is particularly apt and the phrase might well be expanded to include some commentators and newspaper editors who can see in conservation programs merely a purpose to promote high prices and in the unitization of fields only a scheme to deprive small producers of the control of their properties. Nobody who has listened to public hearings on petroleum by committees of Congress or state legislatures can have failed to be impressed by the abysmal ignorance displayed by some of these statesmen and of occasional witnesses appearing before them as to the fundamental conditions governing the finding and handling of oil from field to consumer or of the procedures based on long experience and constantly growing knowledge as to the best means of managing this irreplacable resource and prolonging the period of its availability. A perusal of "Oil for Today—and for Tomorrow" would set right the views of those whose misconceptions arise from ignorance of oil and of the business founded upon it.

Following an introduction by Governor Edward F. Arn of Kansas, chairman of the Interstate Compact Commission, and an elementary exposition of the underground formations in which oil is found and the conditions which govern its recovery, the book deals in a highly informative way with the subjects of conservation, state control, unit production of fields and the avoidance of waste—all topics on which misleading interpretations are frequently voiced.

In the articles dealing with these various questions, there is nothing of argument, but only a lucid and convincing statement of facts. For example, in writing about waste, the conditions leading up to enactment of the first state conservation law by Oklahoma in 1915 are explained and the various forms of waste are listed, including underground waste through an excessive rate of production resulting in dissipation of the energy needed to bring contents of the oil reservoir to the surface and consequent failure to recover more than a small proportion of the total oil in place. "Reasonable market demand" as a rule of production is explained as requiring the maintenance of output sufficient to meet all current requirements, but not to the extent of involving wasteful above-ground storage or the closing down of wells still capable of substantial yields. It is pointed out that state regulation never restricts production below reasonable market demand. If it did, other states with excess productive capacity would immediately increase their outturn, since competition for available markets is always keen among oil companies.

Similarly, the history of unit operation of producing fields is traced to show that far from infringing on the rights of small producers, it actually protects their interests and benefits them by multiplying from two to five times the total volume of oil ultimately recoverable.

Factual information of this sort, attractively presented, is of value not only to the oil industry, but to the nation as a whole by encouraging efficiency and extending the life of this most valuable natural resource.

Circulation of this small volume on the broadest possible scale, by spreading popular knowledge of the oil industry, cannot fail to create good will. Copies of "Oil for Today—and for Tomorrow" may be obtained on application to the Interstate Oil Compact Commission, Oklahoma City, Okla.

World crude output higher in first quarter of 1954

WORLD PRODUCTION of crude oil in 1954 increased 142,000 b/d in the first quarter to 13,189,300 b/d, according to estimates prepared by WORLD PETROLEUM on the basis of field reports from various countries. Production was nearly back to the peak levels reached in the third quarter of 1953 when output averaged 13,195,900 b/d.

Increases in output in the first quarter as compared with the last three months of 1953 were almost equally divided between eastern and western hemispheres. Western hemisphere nations increased their output 66,800 b/d and eastern nations 74,800 b/d.

In the western hemisphere, South American output was up 36,000 b/d and North American 31,000 b/d. Venezuela normally has an increase in production during the winter months to supply peak fuel oil requirements. The Venezuela production level in the first quarter was 185,000 b/d higher than in the third quarter of last year and 28,000 b/d higher than in the first three months of the heavy fuel season. Small increases were attained in Colombia, Argentina and Chile.

All of the increase in North America was in the United States. Cold waves in January had the effect of wiping out excess inventories of fuel oils and encouraged American producers to enlarge their crude output to about 6,300,000 b/d from last year's low point of 6,259,000 b/d reached in the final quarter.

Canadian production was adversely affected in March when nominations by Imperial Oil Ltd. were cut back sharply because of refinery maintenance shutdowns. Alberta nominations were reduced from 258,468 b/d in February to 181,131 b/d in March, a cut of 30 percent. Effect of the shut-downs was to reduce Dominion crude demand from 268,000 b/d in February to perhaps 195,000 b/d in March.

Outside of the Soviet bloc there was little change in European production during the past three months. Germany was an outstanding exception as its steady post-war climb continued unabated. German output rose 24.6 percent in 1953 to 42,300 b/d. January production this year averaged 46,700 b/d. It is estimated that the average for the year will be about 50,000 b/d. Drilling in Germany recently has been averaging 151,000 feet per month. Total for 1953 was 1,801,272 feet compared with 1,563,969 feet in 1952, an increase of 12 percent.

A recent issue of Erdoeldienst in Vienna reported that the Soviet Union produced 52,500,000 metric tons of crude in 1953, Romania 9,100,000 tons, Hungary 500,000 tons, Poland 250,000 tons, Albania 200,000 tons and Czechoslovakia 120,000 tons. Except in the case of Romania, these figures are well in line with estimates which have been accepted generally in the west. Romanian production claimed by official sources is about twice as great as that estimated by many western observers.

First quarter crude production in the Middle East was 55,000 b/d higher than in the final quarter of 1953 and 12,000 b/d higher than the average for all of last year. Iraq production was up 10,000 b/d and Qatar 15,000 b/d. Largest increase was in Saudi Arabia where output climbed 98,900 b/d to 940,000 b/d. This was a new record. It was directly contrary to the trend in Kuwait, where output dropped 70,600 b/d to 844,400 b/d. Last year Kuwait produced more than a million barrels of crude in a single day from time to time, and average for the year was 862,200 b/d. The Neutral Zone now is producing on a commercial basis. Average amount moving to market currently is estimated at 3,000 b/d.

Iraq production in the past three months averaged about 595,000 b/d, continuing the upward trend of the past two years. The Iraqi Government recently offered its royalty oil for the year 1955 and indicated in its offer that output is expected to average about 625,000 b/d.

Activity is increasing in Egypt where California interests have been drilling in the Sinai region and Continental and Ohio oil companies have taken a large concession in the western desert.

Passage of the new oil law in Turkey is expected to stimulate exploration in that country.

When Iran will rejoin the major producing countries of the world still is problematical, although negotiations to this end appear to be progressing normally.

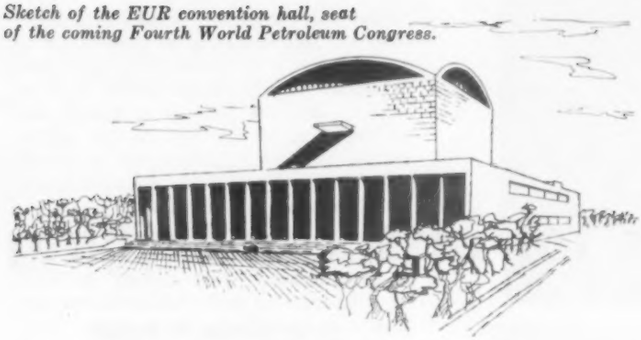
In the Far East there has been little change in output. Commercial production now is being undertaken in Assam Oil Company's discovery near Digboi. The company feels that a major discovery has been made.

United States crude production dropped to 48 percent of the world total in the first quarter compared with 49 percent in 1953. The Western Hemisphere produced 68 percent compared with 69.5 percent in 1953.

WORLD CRUDE OIL PRODUCTION
(Thousands of Barrels Daily)

	1954 First Quarter	1953 Fourth Quarter	1953	1952
NORTH AMERICA				
United States	6,300.0	6,259.0	6,466.5	6,264.5
Canada	239.0	249.0	221.3	167.0
Mexico	190.0	190.0	198.2	214.8
Total	6,729.0	6,698.0	6,886.0	6,646.3
SOUTH AMERICA				
Venezuela	1,892.0	1,864.0	1,764.6	1,803.9
Colombia	112.0	107.8	108.0	105.8
Argentina	83.0	80.8	77.9	68.2
Trinidad	62.5	62.3	61.2	57.4
Peru	45.0	44.7	44.6	45.5
Equador	8.0	8.0	8.0	7.7
Bolivia	1.5	1.5	1.4	1.4
Cuba	0.1	0.1	0.1	0.3
Brazil	2.8	2.8	2.7	1.9
Chile	4.3	3.4	3.2	2.2
Total	2,211.2	2,175.4	2,071.7	2,094.3
WEST. HEMISPHERE	**8,940.2**	**8,873.4**	**8,957.7**	**8,740.6**
EUROPE & AFRICA				
Austria	60.0	60.0	59.5	55.0
Germany	48.0	44.7	42.3	33.9
Netherlands	17.1	16.9	15.5	13.6
Hungary	14.0	14.0	14.0	9.5
France	8.0	7.5	7.0	6.6
Yugoslavia	3.0	3.0	3.0	3.2
Algeria	2.8	2.8	2.0	0.8
French Morocco	2.1	2.1	2.1	2.1
Italy	2.0	2.0	1.9	1.3
United Kingdom	1.1	1.1	1.1	1.1
Total Europe Exc. USSR & Sat.	158.1	154.1	148.4	126.3
USSR	1,075.0	1,060.0	1,040.0	940.0
Romania	95.0	95.0	92.5	90.8
Poland	4.0	4.0	4.0	4.0
Albania	3.0	3.0	3.0	3.0
Czechoslovakia	2.5	2.5	2.5	2.5
Total USSR & Sat.	1,179.5	1,164.5	1,142.0	1,040.3
Total Europe	1,337.6	1,318.6	1,290.4	1,166.6
NEAR & MIDDLE EAST				
Saudi Arabia	940.0	841.1	845.0	822.5
Kuwait	844.4	915.0	862.2	752.4
Iraq	595.0	585.3	574.1	383.4
Qatar	95.0	79.6	85.9	68.4
Egypt	46.0	46.7	46.3	45.0
Bahrain	30.0	30.0	30.0	30.1
Iran	28.0	28.0	26.8	27.5
Neutral Zone	3.0	—	—	—
Turkey	0.6	0.6	0.5	0.4
Total	2,582.0	2,526.3	2,470.8	2,127.7
FAR EAST & OCEANIA				
Indonesia	201.3	201.1	203.6	170.9
British Borneo	101.0	101.0	100.6	104.5
Japan	6.0	6.0	5.8	5.8
India	7.0	7.0	6.5	5.5
New Guinea	4.8	4.8	4.8	4.7
Pakistan	4.4	4.4	4.4	4.1
Burma	2.5	2.5	2.5	2.3
China	2.5	2.5	2.1	2.0
Total	329.5	329.4	329.9	299.8
EAST. HEMISPHERE	**4,249.1**	**4,174.3**	**4,091.1**	**3,596.1**
WORLD TOTAL	**13,189.3**	**13,047.7**	**13,048.8**	**12,336.7**

Sketch of the EUR convention hall, seat of the coming Fourth World Petroleum Congress.



Plan fourth world petroleum congress

FOLLOWING THE DECISION of the organizing committee of the Fourth World Petroleum Congress as to the location and date of its meeting, plans for the convention are maturing rapidly. The Congress will be held in Rome from June 6 to June 15, 1955. The choice of Rome instead of Venice, as had been earlier proposed, was based on the location of the capital city and the availability of commodious quarters for general and sectional meetings.

As now determined, the Congress will be held at the convention buildings of EUR (Rome Universal Exposition) located in the Citta Parco (Park City) outside the city limits, but within easy reach of central and residential areas. The general sessions will meet in the Palazzo dei Ricevimenti e Congressi, the main auditorium of which has a seating capacity of one thousand. Separate rooms in the same structure will be used for meetings of the various sections of the Congress.

The Citta Parco was originally planned by Mussolini, who intended it to become the site of a huge exposition to be held in 1952. For reasons well known, this plan was never carried out, but the area has since been developed in accordance with the primary design as a place for permanent exhibition halls and public museums. Among the latter are the Palazzo della Civilta Italiana expitomizing Italian domestic and communal life and the Palazzos of Ancient Art, Modern Art and Science. The whole area is elaborately landscaped with fountains, lakes, an open air theatre, athletic and recreation fields. A striking feature is a 125-foot obelisk dedicated to Guglielmo Marconi, inventor of radio, which is decorated with a number of reliefs executed by the artist Arturo Dazzi.

Members of the General Organizing Committee of the Congress in charge of local arrangements for the meeting are: Prof. Marcello Boldrini, chairman; Dr. V. Cazzaniga, Gr. Uff. G. D'Amelio, Prof. R. Fabiani and Prof. M. se F. Pennavaria, vice chairmen; and Dr. A. A. Muston, general secretary.

The Permanent Council of the Congress, which is the governing body, is headed by Dr. E. V. Murphree, president of Standard Oil Development Co., United States, as chairman. Vice chairmen are G. A. Tuyl Schuitemaker, the Netherlands; S. Scheer, France; C. A. P. Southwell, Great Britain; and Dr. C. Perez de la Cova, Venezuela. The honorary treasurer is Col. S. J. M. Auld of Great Britain, and the general secretary is D. A. Hough of the Institute of Petroleum, London. Members of the Permanent Council representing participating countries are: F. S. Clulow, Dr. K. G. Mackenzie and Dr. E. V. Murphree, United States; Col. S. J. M. Auld, T. Dewhurst and C. A. P. Southwell, Great Britain; R. Navarre, S. Scheer and Prof H. Weiss, France; Dr. H. Kupper, Austria; Prof. P. Erculisse, Prof. F. P. Malschaert and P. R. de Ryckere, Belgium; Dr. R. K. Stratford, Canada; Prof. C. Padovani, Prof. G. Roberti and Dr. T. A. Salvadori, Italy; Senator Antonio J. Bermudez, Mexico; J. A. Beukers, Dr. J. N. J. Perquins and G. A. Tuyl Schuitemaker, Netherlands; and Dr. C. Perez de la Cova, Venezuela.

The Congress will extend from Monday, June 6, 1955 to June 15. The opening ceremonies will take place at a general meeting on June 6 and will be followed by section meetings and general lectures on June 7, 8, 10, 13 and 14. June 9, a holiday in Italy, will be devoted to sightseeing and trips of technical interest in the vicinity of Rome. Longer trips to suit the wishes of those attending the Congress will be arranged to other parts of Italy for the four days immediately following the meeting (June 16 to 19 inclusive).

It is tentatively planned to have four special addresses at general meetings as was done at the Third Congress at The Hague. These will deal with broad problems of the petroleum industry and will be delivered by prominent members of the international industry, subjects and speakers to be decided later.

Nine sections have been established to hear and discuss papers dealing with technical subjects. These sections, with the topics they will consider, are as follows:

Section 1: Geology and geophysics.

Section 2: Drilling and production.

Section 3: Physical operations in oil processing. Processes involving chemical conversions.

Section 4: Production of chemicals from petroleum.

Section 5: Composition of petroleum; analysis and testing.

Section 6: Utilization of oil products.

Section 7: Equipment, materials, corrosion.

Section 8: Transport, storage and distribution.

Section 9: Statistics, education and training.

Some 150 papers have been selected for presentation at the section sessions, each of which will have as chairman a specialist in the subjects to be discussed. National committees in each of the countries participating officially in the Congress are actively promoting interest in the proceedings of the Congress and in attendance at its meeting. In addition, announcements regarding it have been sent out by the general secretariat to all those who attended previous congresses. Advance replies indicate that attendance at the Rome meeting probably will exceed that of any of the three preceeding gatherings.

Members of the Permanent Council looking at the plastic model of EUR (Rome Universal Exposition). Left to right: Messrs. Stratford (Canada), Schuitemaker (Netherlands), Clulow (USA), Perquins (Netherlands), Gibson (Great Britain), Zwartsemberg (Netherlands), Malschaert (Belgium), and Hough (secretary of the Permanent Council).

California

has ambitious plans for offshore drilling

Richfield's Parcel "A" in Long Beach harbor. The producing wells and pipe lines are set beneath ground level. All of these wells are whipstocked out beneath the harbor, some over half a mile.

By Charles N. Pollak

ALTHOUGH NO OUTSTANDING offshore development has taken form in California since President Eisenhower signed legislation returning the so-called tidelands to the states, the period since May 22, 1953 has been one of much progress toward bringing the more promising of the submerged lands under the drill.

The next step is ready to be taken with the spudding of one of the most significant tidelands tests in the history of the Golden State.

The well in question is about to be drilled in the open Pacific about a mile and a half off the city of Seal Beach by The Texas Co. and Monterey Oil Co., with the latter as operator. Monterey is currently putting finishing touches on a cylindrical filled-land drill site 75 feet in diameter from which one vertical and two directional wells will be drilled in an attempt to reach an extension of the nearby Wilmington field's highly productive Ford zone. Brown Drilling Co. has been awarded a contract to drill three wells from the artificial island.

While this man-made island off Seal Beach is claiming considerable attention, still more electrifying news on submerged lands activity has come from Macco Corporation, international construction firm headquartered in Paramount, Calif.

Macco's president, John MacLeod, told WORLD PETROLEUM that his company, in a joint venture with Stone and Webster Engineering Corporation, had been awarded a contract by a group of major oil companies for the design, engineering and construction of an offshore platform for drilling in 250 feet of water.

The group consists of Continental Oil Co., Shell Oil Co., Superior Oil Co. and Union Oil Co. Robert Bauer of Union Oil Co. is manager of offshore operations for the group.

MacLeod said the unprecedentedly huge structure would be able to withstand 30-foot waves, 70-mph gales and the earthquake hazards common to the Pacific Coast.

Macco, he explained, has been working on engineering studies for such deep-water structures for the past 10 years. "There's nothing about them that isn't difficult," he said, "but it's our business to plan ahead so we can build for the oil industry wherever it wants to drill."

Aerial view of Huntington Beach field shows Southwest Exploration Co. lease and its mass-whipstock operation. Lone derrick moves on tracks to service each well as necessary.

While MacLeod did not provide details of the project, he explained that the platform and substructure to be used in the drilling would be fabricated on shore and floated to the site selected. Either jetting or drilling will be employed to place the foundations, depending on the composition of the ocean floor.

References to the water depths to be dealt with as well as the timing of Mr. MacLeod's announcement make it implicit that the project will be undertaken in the federally-controlled continental shelf area rather than in state-owned coastal waters. The reason is that California's submerged lands within the traditional three-mile limit have been and still are off-limits to drilling under the provisions of the Public Resources Code.

One of these specifies that offshore drilling is banned except where it can be demonstrated that there is drainage or a threat of drainage from upland coastal pools. The Monterey-Texaco venture belongs in this category because of a Monterey well whipstocked from an upland location at Seal Beach seaward to within 600 feet of the artificial island. This Ford zone well, with a distance of 9,700 feet from the bottom of the hole to the derrick, vertical depth of 5,770 feet and drill depth of 12,180 feet, has averaged 30 b/d of 28 gravity oil for almost five years.

The frustrating drainage requirement points up the fact that the main obstacles to broad exploitation of California's offshore areas have been political and legal rather than technical, for the only way California operators can drill for undersea oil at present is to move beyond the shallow waters under state control into the deeper continental shelf areas retained by the federal government.

An abortive attempt to eliminate the drainage requirement was made toward the end of the 1953 session of the California state legislature. It failed because adjournment was imminent and the oil industry was anything but unanimous on the bill's provisions. The Senate did set up an interim committee on oil and gas development on state lands which has staged a series of hearings on proposals for the liberalization of the code.

The revelation that major companies plan to strike out boldly in water depths hitherto deemed impractical for drilling platforms gives credence to reports long heard on the coast concerning deep-water projects. These have made it a fair assumption that virtually every company possessing the financial resources necessary for seagoing exploration has developed its own designs and models of the type of structure peculiar to offshore drilling. One of these reports, in fact, goes beyond the Macco disclosure and says that a major company is working on the design of a platform suitable for erection in 350 feet of water.

While details are sparse, it is also the assumption that the large-diameter reinforced concrete caissons which Creole Petroleum Corporation has used for years in Lake Maracaibo, Venezuela, will inspire the engineering and construction of the Pacific Coast structures.

In addition, the American Shell Oil Co., a concern headed by J. R. Pemberton, consultant and former California oil umpire, has proposed construction of tunnels out under the ocean bottom to top off an offshore extension of the rich Ventura Avenue field that is believed to exist.

The firm would use a system of vertical shafts and horizontal galleries leading to huge "drilling chambers" that branch off from the main tunnel to exploit the presumed field. The system has been patented by Hillman A. Hansen, a mining engineer who also has patents on a towering mobile seagoing exploration platform. The latter would be used to determine the extent of an offshore field before a tunneling project is undertaken.

More tangible evidence of the interest in California's submerged lands is available in the records of the State Lands Commission. They show that intensive geophysical exploration of coastal waters since 1944 has involved participation of the following companies:

Continental Oil Co., General Exploration Co., General Petroleum Corp., Hancock Oil Co., Honolulu Oil Corp., Humble Oil & Refining Co., Macco Corp., Ohio Oil Co., E. W. Pauley, Phillips Petroleum Co., Richfield Oil Corp., Shell Oil Co., Signal Oil and Gas Co., Standard of Calif., The Texas Co., Tide Water Associated Oil Co., Union Oil Co., Western Gulf Oil Co., and Wilshire Oil Co.

The actual field work has been done by United Geophysical Co of Pasadena, Western Geophysical Co. of Los Angeles, and Geophysical Service, Inc., of Bakersfield. The area covered has extended from Point Estero, near San Luis Obispo, south to San Diego County, and as far offshore as the outer Channel Islands.

According to last year's National Petroleum Council study of the nation's tidelands oil possibilities, the western continental shelf comprises an "immediately prospective" area of 300 square miles in water depths to 50 feet. This area forms part of some 19,000 square miles of West Coast shelf lands to 600 feet in depth.

By way of comparison, California's "immediately prospective" area seems insignificant next to the 14,000 square miles of submerged lands in this category along the Gulf Coast. The NPC study estimated that the two coastal areas might produce around 200,000 b/d of oil and 600 to 800 million cubic feet daily of gas within five years of the commencement of drilling.

California's tidelands, of course, have been productive for many years within the restrictions imposed by state law. Cumulative production from state leases in eight fields exceeds a quarter billion barrels, with the bulk coming from hundreds of whipstocked wells in the Huntington Beach field. In addition, a substantial portion of the Wilmington field's 117,000 b/d comes from beneath Long Beach harbor and thus geographically, if not by common definition, can be classed as tidelands oil.

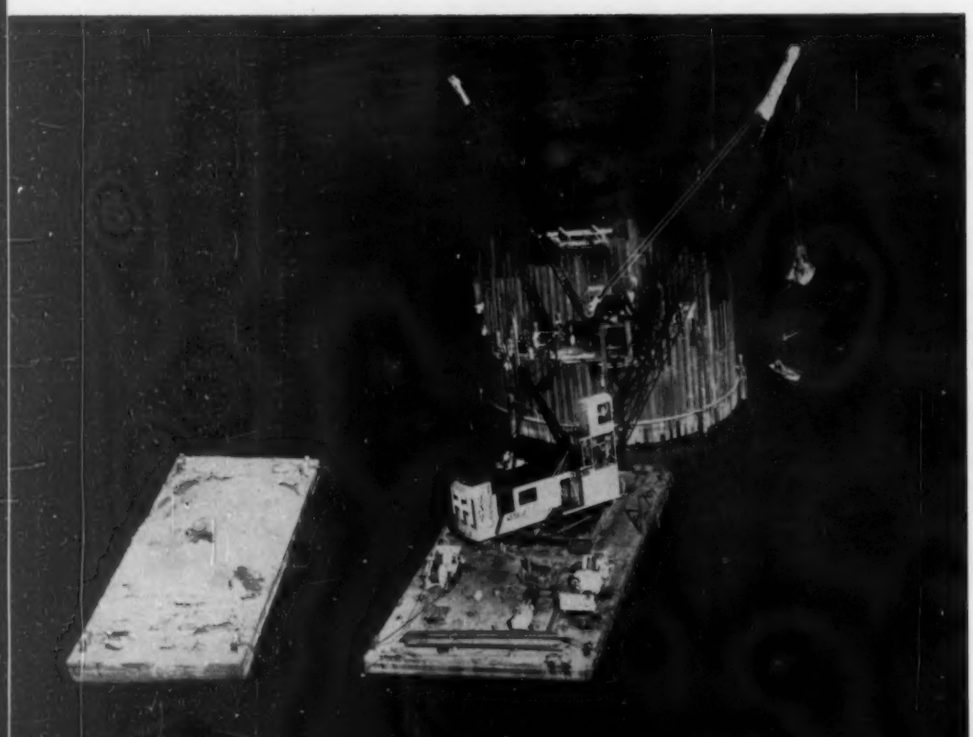
In these proved areas there has been constant activity despite the restrictions of state law. In state leases alone, according to recent testimony of Col. Rufus W. Putnam, executive officer of the Lands Commission, some four or five new wells per month are being completed. The City of Long Beach, looking to untapped areas for additional production, is making a seismic survey of the lands beneath harbor waters. And the City of Los Angeles was recently told by W. H. Geis, consultant, that a major field may lie beneath the entrance to the breakwater protecting its San Pedro harbor.

A seemingly inconsistent aspect of the California tidelands picture stems from the ease with which Long Beach proceeds with the development of its oil properties without regard for state restrictions. Actually, there is no inconsistency: Long Beach, along with a few other coastal cities, was granted full title to its ad-

A seismographic fleet of five boats works off the coast of California. The small boat to the right has just let go 90 pounds of black powder which blew up the geyser of water. Soundings from the blast are picked up by instruments on a headquarters boat.

The bit-like instrument in the conter of the picture is dripping pieces of core taken from the bottom of the sea. Ex-minesweepers have been especially rigged to bring up cores from the ocean floor.

Recent aerial view of Monterey-Texaco filled-land drill site shows rock barged over from nearby Catalina Island being dumped around huge cylindrical structure made of interlocking sheet steel piling.



jacent submerged lands by state law long before oil was discovered within the city limits.

Hence, Redondo Beach and Santa Monica, for example, control certain submerged lands under the terms of laws passed more than three decades ago which extended their city limits seaward. Both municipalities are currently negotiating with oil companies seeking city leases. In the case of Santa Monica, Standard of Calif. is reported to have asked permission to build a steel island a mile offshore as part of a $2 million exploratory program there. At Redondo Beach, Signal Oil & Gas Co. wants to build a pier to exploit a possible offshore pool.

Another city which had the foresight to stake out its own tidelands is Newport Beach, and the wisdom of the city fathers is now paying off in oil royalties from California's first post-Eisenhower offshore discovery. Monterey Oil Co. late last year completed Newport Beach 1 for 60 b/d of 19 gravity oil, with Humble Oil & Refining Co. holding a half interest. The well was whipstocked from a shoreline location. A second directional hole has been carried below 4,000 feet and a third is planned. Monterey regards all three wells as wildcats.

As for its filled-land drill site off Seal Beach a few miles to the northwest, Monterey is optimistic. Lowell Stanley, chairman of the board, has termed the Seal Beach lease "one of the most significant and promising properties any oil producer has in California."

E. E. Pyles, Monterey's executive vice president, told WORLD PETROLEUM that the initial well will be taken to a basement at between 7,000 and 8,000 feet. If it is successful and the two directional holes are sufficiently encouraging, then Monterey and Texaco will expand the island's area to from five to 10 acres. The enlarged structure, he said, would eventually form part of the proposed extension of the federal breakwater enclosing San Pedro and Long Beach harbors to a point opposite Seal Beach.

Pyles said the large island probably would cost between $3 million and $5 million. The existing structure, which consists of interlocking sheet steel piles buttressed by riprap on the outside and sand on the inside, is reported to have cost about $600,000. Pyles attributed a third of this sum to costs arising from many months' delay caused by an unsuccessful effort by the City of Seal Beach to sue the project out of existence.

The Monterey-Texaco venture, novel as it is, represents just a sample of things to come in California's submerged lands. For it is safe to say that engineering marvels will be the rule rather than the exception during the next few years as the petroleum industry applies its vast technical and financial resources to finding and producing oil from far beneath Davy Jones' locker.

Plans completed for prompt construction of Sui gas line

FOLLOWING THE RAPID development of the Sui gas fields in Baluchistan since the initial discovery last year and the completion of financing plans, it has been decided to proceed at once with the construction of a pipe line to convey the gas to Karachi, Pakistan. For this purpose the Sui Gas Transmission Co. has been organized with a capitalization of £9,000,000, or roundly $25,000,000.

The government of Pakistan and affiliated British interests have invited bids for building of the line and plans contemplate an award in April of the construction contract with several international pipe line builders expected to figure among the bidders. As specified in the surveys already made, the line will be of a 16-inch diameter and 350 miles in length, extending from the Sui fields southward to Karachi and serving also Sukkur, Rohri, Hyderabad and Kotri. Tentative completion date is set for May 1956.

The primary factor in the organization of this project has been the Burmah Oil Co. Ltd., operating through its affiliate, Pakistan Petroleums Ltd. Drilling of the Sui wells was done by the latter and the surveys of possible routes for the pipe line were made by engineers of the Burmah company. Several months ago, at the request of the Pakistan Government, W. E. V. Abraham, managing director of Burmah, went to Washington to initiate negotiations for a loan from the International Bank for Reconstruction and Development which is designed to cover approximately 55 percent of the construction cost. Burmah officials also interested the Commonwealth Financial Development Corp. which has undertaken to subscribe £1,000,000 to the capital of the Sui Gas Transmission Co., the first commonwealth investment made by the corporation, which is being matched by a similar subscription by Burmah Oil Co. interests. Remaining equity capital is being provided by the Pakistan Industrial Development Corp. whose chairman, Ghulam Farugue, has been an enthusiastic supporter of the project, and by other Pakistan interests.

The Sui pipe line is hailed in Pakistan as an important aid to the economy of the country, both in relieving the drain on foreign exchange required to pay for imports of coal and as an encouragement to industrial development which is regarded as the nation's most urgent need. Pakistan, during its union with India and up to the present time, has been mainly a producer of raw materials and the development of manufactures to supply its own markets and ultimately for export is a national aim. Coal imports range around 1,600,000 tons per year. There is a production in the northern districts of about 600,000 tons used locally. It is estimated that the gas line will supply initially an amount of fuel energy roughly equal in heating value to current coal imports, with expansion later to cover the anticipated growth in demand. Specific uses for gas are power generation, reduction of ores, pumping, distillation of sea water, fuel for cotton spinning mills, ceramic plants and other industrial establishments as well as for water heating and cooking in homes.

The various sections of the line are listed as follows:

Sui to Sukkur-Rohri	70 miles
Sukkur to Hyderabad-Kotri	170 miles
Hyderabad-Kotri to Jhimpir	35 miles
Jhimpir to Karachi	75 miles
	350 miles

Engineering studies for the Sui project were directed by C. Sterling Snodgrass, consulting engineer of Washington, D. C., and former head of the foreign division of the Petroleum Administration for Defense. Mr. Snodgrass visited Pakistan in 1953 and made a report for the Burmah Oil Co. and Pakistan Petroleums Ltd. He is still serving as consultant to the gas company.

Natural gas flare at Sui well No. 1 during production test.

The summary of Mr. Snodgrass' report included the following conclusions:

"Sui gas represents a timely supplement to Pakistan's meager supplies of indigenous fuels and is a key to the agricultural and industrial betterment of the country.

"Sui gas is a perfect fuel for stationary heat and power installations and a ready-made carbon-hydrogen molecular skeleton for the manufacture of synthetic fertilizers. Its availability should stimulate and encourage increased agricultural and industrial production.

"The proven reserves of Sui gas are estimated as 2,280,000 million cubic feet, which is sufficient to supply 100 million cubic feet per day for 60 years. This quantity of gas is the equivalent in effective heating value of approximately 1,600,000 tons of imported coal per year.

"To make the most prompt and effective use of this gas in the economy of West Pakistan, a pipe line is recommended from Sui to Karachi via Sukkur-Rohri and Hyderabad-Kotri.

"The prospective fuel demand along this pipe line route is estimated to increase from an average requirement of 45 million cubic feet per day for cement and power plants during the first operational stage of four years to over 100 million cubic feet per day by 1963 to fuel West Pakistan's power and industrial development programs.

"To meet this requirement, a 16-inch diameter pipe line approximately 350 miles long, at an initial capital cost of about nine million pounds, has been selected for estimating purposes.

"The estimated transportation costs on this capital base give ample scope for delivered gas prices which are favorable in comparison with alternative fuels.

"In foreign exchange, the substitution of Sui gas for imported fuels after paying all local costs saves the equivalent of about 3,240,000 pounds sterling per year during the first stage of operation and saves some 8,500,000 pounds sterling per year at full load.

"The substantial savings and benefits which will result from the installation of the Sui pipe line emphasize the desirability of an early decision in order that the line may be completed and in operation by 1956."

Arabia's

Shown with their late father, King Ibn Saud (seated), during the celebration of the opening of the Saudi Government Railroad in October 1951 are His Excellency Crown Prince Feisal and the new king of Saudi Arabia, Saud Ibn Abdul Aziz. At the time this photograph was taken King Saud was Crown Prince of Saudi Arabia and Prince Feisal Foreign Minister.

J. H. Gildea, manager of the Saudi Government Railroad, holds the golden spike which was driven by His Excellency, Crown Prince Saud of Saudi Arabia. This ceremony took place at the completion of main line trackage of the railroad at Riyadh in October 1951.

King Saud Ibn Abdul Aziz of Saudi Arabia is shown with F. A. Davies, chairman of the board and chief executive officer of the Arabian American Oil Co. (center), and R. L. Keyes, president, at Hamilton House in Dhahran during the King's visit in January.

THE QUESTIONS WHICH AROSE immediately in the minds of Western observers when King Ibn Saud died on November 9, 1953 were:

What will this mean to relationships between East and West? And: What will it mean in terms of continued accessibility of oil?

For those whose interest in the Middle East goes even deeper, there was the further question: What will this mean to the people of Saudi Arabia, and of the Middle East generally?

Happily, all of the evidence indicates that the answers to these questions are reassuring.

The new King, Saud Ibn Abdul Aziz, is a strong and able successor to his renowned father. He is intelligent and sincere. He is thoroughly trained in the art of government, widely traveled in Europe and the United States, and genuinely respected by his subjects and by foreigners with whom he has had business or diplomatic relationships. He is a warrior who wants peace: a devout Muslim who respects the faith of others.

The new Crown Prince, the Amir Faisal, is a soldier-diplomat-administrator who has demonstrated his skill in international affairs as Foreign Minister and as his country's representative in the United Nations since its inception.

Both King and Crown Prince have repeatedly expressed their friendship for the United States and their approbation of the development of their great oil resources by the Arabian American Oil Co. (Aramco). Both have voiced their desire to see that the great wealth from these resources is utilized to advance the welfare of their people.

In brief, both the western nations and the Saudi Arabs have solid reason for regarding the new regime as both stable and progressive and the reason this is true is that a truly remarkable job of building was done by the late, great Ibn Saud.

It was in January 1902 when the 20-year-old son of Abdul Ruhman al Saud recruited 39 men for an assualt on Riyadh, long the family capital, but then held by the powerful house of Rasheed. The name of the son was Abdul Aziz Ibn Saud.

The assault was successful, but 32 years of struggle lay ahead before Ibn Saud was to consolidate his domain. When he began his crusade, the Rasheeds were the most powerful force in central and northern Arabia. After many a battle, over nearly two decades, he conquered them. He ousted the Turks from the eastern province of Al Hasa,

able new king builds on solid ground

now the center of oil development. He wrested the western province, the Hijaz, which embraces the holy cities of Mecca and Medina, from the Sharif Husain, the leader who worked with Col. T. E. Lawrence in the Arabian revolt during World War I. He put down a defiant governor in the small southern province of Asir; forced a boundary settlement with Yemen and, as his final task in unifying and pacifying the peninsula, subdued a revolt of the desert religious fanatics known as the Ikhwan.

At last, in 1933, he was able to say prophetically: "From now on, we will, Insha Allah (with God's will), lead a new life and go forward."

In that same year, Ibn Saud set about to bring progress as well as unity to Arabia, so he decided to find out whether there might be oil beneath the sands of his hard-won kingdom. Rejecting the proposals of British, Japanese and German interests, he awarded a concession to the Standard Oil Co. of Calif. The California Arabian Standard Oil Co. (now Aramco) was established to operate the concession. Since oil was discovered in commercial quantities in 1938, Saudi Arabia has become the third largest oil-producing country in the world.

Forward-looking Ibn Saud saw in the oil revenues the opportunity to bring a better life to a land which for so long had known want, and he had the good fortune to have, as his concessionnaire, a company that shared this desire.

The company went far beyond its contractual obligations in providing training and opportunity for its employees and in helping the Saudi government in many ways in the fields of public works, health, water supply, agriculture and irrigation, education and community development. In consequence of government and company effort, separately and in cooperation, Saudi Arabia, over a 20-year period, has undergone the phenomenal transformation which is now so widely known.

Meanwhile, the wise and practical King Ibn Saud had not forgotten that he would die some day and he had not forgotten the wars which historically had been fought in the peninsula over succession. So it was that, soon after he consolidated his kingdom in 1933, he began training his sons in leadership and government.

Two older sons had died, but Saud, the third son, was only 13 years old when he was given his first assignment of responsibility. It was just after the 1915 revolt of the Ajman tribe and an insurgent leader had fled to Qatar. The young Amir Saud was designated to head a delegation to bring the rebel back. He did so.

In the years immediately after World War I, the King began to look increasingly to the Amir Saud for support in carrying the burdens of government. Saud participated constantly in the councils at Riyadh, and, in addition, served as Viceroy of Najd, the north-central province where the family has its centuries old ties.

Yet, although the king was plainly grooming him as heir to the throne, succession in Arab lands does not automatically follow the custom of primogeniture. So, when Saud's elder brother Turki died in 1919, during the influenza epidemic which followed World War I, Saud did not receive official designation as heir apparent. It was not until May 1933 that a proclamation designating him as Crown Prince was drawn up by the Council of Ministers and the Consultative Council and ratified by royal decree.

Meanwhile, Amir Saud was having his share of battle experience, which had started in his early 'teens. He accompanied his father in the invasion of the Hijaz, which resulted in the overthrow of Husain. Thereafter, he led a successful expedition against tribes which had been affiliated with Husain and the job was done so successfully that more than 3,000 camels and 10,000 sheep were distributed among the warriors as booty.

He took part in a whole series of battles against the house of Rasheed and was the one to accept the final surrender in 1920. Among his more noteworthy victories was that at the battle of Dafinah, where he demonstrated exceptional initiative and bravery. Many places in Najd are pointed out today as scenes of Saud's victories.

In January 1934, less than a year after his designation as Crown Prince, Saud was again leading an army, the result of the border dispute with Yemen. He was compelled to operate in extremely difficult mountainous territory, but within four months Yemen acceded to the generous terms dictated by Ibn Saud.

This campaign was probably the motivation of an assassination attempt a year later, in March 1935, when Saud's quick thinking and courage were again demonstrated. He and his father had made the pilgrimmage to Mecca, and were walking in the crowd when they were suddenly attacked by three Yemeni pilgrims. One of the assailants, rushing at the King from the front, was shot down by guards, but another had raised a knife and was plunging it toward the King's back when the Crown Prince threw himself in the path of the blade and took a wound in his shoulder.

King Saud was reportedly born in Kuwait on the night of January 15, 1902, when his father and his little band of men captured Riyadh. Beginning his studies at the age of seven under the religious scholar 'Abd al-Rahman ibn Mufairih, he learned to read and write, and within four years had memorized the Koran. After six years of formal education, he contracted smallpox and was withdrawn from school.

The new King has traveled extensively. He visited the Netherlands in 1935 and, in 1937, following a visit to Iraq, he went to Italy, Switzerland, France, Belgium, the Netherlands again, and England, where he attended the coronation of George VI.

In January 1947, at the invitation of President Truman, he came to the United States, and after a series of official functions in Washington, toured the country from coast to coast for approximately six weeks. On his return to Washington, he was awarded the Legion of Merit by the President.

As an indication of the late King's reliance upon him, he was put in full command of the Saudi Arabian Army in November 1939, with the rank of deputy commander, second only to his father.

In addition to his administrative responsibilities he has devoted much effort to projects for his country's advancement, including sponsorship of the Saudi Science Institute at Riyadh, which, with its extensive library, has become an important center of learning.

The new Crown Prince, the Amir Faisal, is known to heads of state and diplomats throughout the world because of his long participation in United Nations affairs. Born in 1904, he also had a distinguished military career during the period of Arabian unification. For more than 20 years he was his father's Viceroy in the Hijaz, and president of the Council of Ministers.

All in all, it may be said with confidence that the affairs of government in Saudi Arabia are in strong hands; that there is an earnest desire for friendship with the free nations; that the oil development will go forward on a solid basis of mutual understanding; and that the new King and his regime will devote their talents to a program which will benefit all the people in Saudi Arabia.

Permanent completions

South Texas well set up for permanent completion. The rig has just been moved off and the rig floor is still in place. The lubricator mounted on the well head here is used to pass one-inch aluminum extension tubing into the hole. The lubricator resting on the personnel platform is an auxiliary, heavy duty lubricator used when a steel extension is run in the hole to replace the aluminum extension during acidizing operations. At the left is the acid pit. The well head was installed prior to removal of the rig.

save time and money in workovers

By J. E. Adkins

ONE OF THE MOST commendable traits of the petroleum industry is its constant search for more economical methods of oil recovery. This industry-identifying feature is manifested with increasing frequency by announcements of new equipment, new methods, or improvements of both. Some of these new developments are startlingly new, others routine. Probably the most talked-about development currently is the so-called "permanent type" well completion method.

In the Gulf Coast areas of Texas and Louisiana, old producers are being worked over at from one- to two-thirds the cost of conventional methods with the new permanent completion process. New wells are being completed by the new method with a saving in rig time of from one to several days. To date, more than one thousand wells, new and old, have seen the application of some part of this new well completion method.

Basically, the process involves the preparation of wells so that the tubing and well head are installed only once during their useful life in the well. The tubing string and other sub-surface equipment are installed while the drilling rig is still on the location, but the permanent completion process allows the rig to be moved off prior to perforating, testing, and bringing in the well. These operations can be performed with wire line equipment several days later, if desired, and usually at considerable savings.

With the reduced workover costs made possible by this new technique, stringer sands may be economically produced, thus increasing over-all oil recovery. Finally, the use of heavy equipment is greatly minimized. Wire line equipment used in a typical permanent completion or workover operation weighs approximately one-half ton while a conventional drilling rig or workover unit weighs some 200 to 300 tons, including pipe in the rack.

What does all this mean? What are the advantages of "permanently" completing a well? What will be the impact, if any, of this new method on future drilling practices of both major and independent producers? To answer these questions it is necessary to go somewhat into the origin of the new completion process.

Back in the 1930's when the "engineering concept" of petroleum recovery was gaining momentum, petroleum engineers felt then, as now, that the most logical way of doing things is the most economical way. They were disturbed by the comparatively ponderous conventional completion methods.

In November 1950, T. A. Huber, chief reservoir engineer for Humble, and two other Humble engineers, T. O. Allen and G. F. Abendroth, presented a paper before a group session at the API annual meeting in Los Angeles. Entitled "Well Completion Practices," the paper outlined "the significance of developments in reservoir engineering as they affect completion practices." It placed heavy emphasis on fitting the proper completion practice to individual reservoir conditions. Included rather unobtrusively in the paper were a few references to "desired development." Here the authors outlined the permanent completion process and made the announcement to the industry of Humble's new idea.

At the time it was estimated that about 20 percent of the total cost of drilling and placing an oil well on production was chargeable to the completion phase. In addition, another 15 to 25 percent of the lease and well expense was spent on workovers and "mechanical repairs" during the life of the well. Here were real costs that could be attacked and possibly decreased with more simplified techniques of completion and workovers.

Moreover, conservation practices established a need for more thorough depletion of known reserves. A great quantity of oil was being abandoned in-place because of a lack of more economical recovery methods. Thin, questionable producing zones encountered during drilling were in many cases passed up for the higher yielding formations. It was not that the production from thin zones was unwanted. It was simply a case of costs exceeding receipts.

Permanent completions now make it possible to test these thin zones at comparatively little cost. Much oil that has been by-passed may now be produced economically. Reserve figures may be boosted considerably.

By the same token, the new method will encourage the maintenance of wells in a higher state of efficient performance since workover costs may be considerably reduced by the new process. Worn or obsolete equipment may be replaced in a fraction of the time and at a fraction of the cost taken by conventional replacement procedures. Wireline-retrievable artificial lift equipment, such as wireline gas lift valves and bottom-hole regulators, chokes and standing valves, as well as chemical injection valves for corrosion inhibitors, may be retrieved and inspected or replaced in case of malfunction at any time with wireline equipment.

In addition, longer use may be obtained from equipment that is brought to the surface for routine inspection. Under conventional workover methods, such down-well equipment frequently is replaced prematurely to save roundtripping it again at an early date. With wireline operation, partly-worn equipment may be readily returned after inspection and replaced at its normal wear-out time.

Three major developments allow many possibilities of the permanent well completion technique to be realized: namely, development of small perforating guns to pass through the tubing, which would be effective enough to obtain adequate penetration through the casing, the cement, and into the formation; a special system of extending a string of temporary tubing beyond the permanent pipe through which squeeze cementing and sand washing operations could be performed, and a cement and cementing technique to permit clearing the casing of cement while effectively sealing off perforations. Of course, it was also desirable that alterations be made to conventional artificial-lift equipment which would contribute to the permanency of the installation, but such alterations and improvements were not entirely essential.

To develop a small gun capable of being lowered through the tubing to perforate the casing, service companies familiar with gun perforators were consulted. A number of this type of perforator are now commercially available. The low filtration rate cement was developed within the Humble company. Several companies were licensed to furnish this modified cement in the field and have been doing so for some time for casing cementing. Otis Pressure Control, Inc., developed a hanger assembly for the tubing extension and various other tools and equipment. These companies are licensed by Standard Oil Development Co. (owner of the patent rights which have arisen as a result of the Humble development) to perform certain phases of the permanent completion processes.

One of the most obvious advantages of permanent completions is its cost-saving feature. With the drill bit going deeper and deeper year after year in search of productive zones and with equipment and maintenance costs headed in the opposite direction, companies are becoming more

and more economy minded. Out of this type of situation naturally comes economical thinking.

When an attractive pay zone is reached the conventional completion method usually calls for from one to several additional days of rig time during which perforating, acidizing and other completion operations are performed. Time costs for these rigs are high. Generally, it costs $1,000 to $1,500 per day to keep a rig on a well, except on off-shore locations where costs are much higher. If trouble is encountered the rig still must remain on the well until the well is brought in.

However, with the permanent completion method the rig is removed once the contract depth is reached and the casing is set and the tubing run in to leave a number of producing zones uncovered. Then the desired producing zone is perforated. Later, it is entirely economical to squeeze-cement that zone without contaminating the formation with mud and to test the thinner zones encountered during drilling. Also, if a better gas/oil or water/oil ratio is desired within a particular productive zone, it is economically feasible to reperforate higher or lower in the zone, as the case may be, in order to change the producing conditions; and this can be done while the well is still alive. All of this is accomplished with wire line operations and with the rig off the well.

Conventional completion and workover costs multiply rapidly at water locations where platforms are required or at marine locations where barges are not utilized. Workover costs of $100,000 to $200,000 under marine conditions are realistic. Thus far, no workover job has been performed offshore with permanent completion methods. However, wells have been set up to make use of the process in workovers and remedial operations and it has been estimated that costs for the workovers may not exceed $20,000 on wells thus prepared.

The chief reason for this greatly reduced cost may be found in the type of equipment used. The infinitely lighter and portable wire line gear is easily transported to the offshore well-site in a small craft and the time consumed is but a fraction of that where a rig is employed. One Humble engineer remarked that "you can practically row the wire line gear out in a canoe."

Permanent well completion methods will have great influence on future drilling programs for both major and independent producers. For any company, the method may afford an economical way of testing or producing stringer sands. Where workover costs average $10,000 per year per well with conventional workover methods, requiring heavy pipe handling rigs, average costs with the permanent completion process should be in the neighborhood of $2,000 to $5,000 per year per well. A company with widespread operations knows that once a well is completed under the new technique its workover expenses will be much lower.

For example, a 6,000-foot well in a Texas Gulf Coast field, previously set up for permanent completion workovers, required only four days for a complete workover including washing sand from the casing, squeeze cementing existing perforations, and reperforating in a higher interval. The itemized cost of the workover is as follows:

Gang labor	$100
Pump truck washing out sand	210
Pump truck pumping cement	297
Cement and services	186
Wireline truck services	257
Perforating (90 shots in 18 feet)	840
Total cost of workover	$1,890

The cost of this particular workover, performed with permanent completion methods, compares favorably with estimated workover costs for the same field of $4,390 when conventional workover methods are employed.

In another instance a wireline workover was performed on a 10,500-foot well in Mississippi at a total cost of $2,100. Time consumed was again four days. The field personnel estimate that this job would have cost a minimum of $5,000 if conventional workover methods had been used.

On a 6,800-foot well on an island in the Mississippi River in northern Louisiana, existing perforations were squeezed and the well was reperforated higher for a total cost of $2,500 in three days' time. The location of this well necessitated a barge trip which took eight hours round trip from Natchez, Miss. The field personnel estimate the job would have cost a minimum of $6,300 if performed by conventional methods, utilizing a small drilling rig, which was located elsewhere on the island at the time. The cost would have been much higher had it become necessary to barge a rig to the island to

Wireline operator is running aluminum extension tubing into the hole. This tubing will be landed at the bottom of the permanent tubing after which it will be used for cementing, sand washing, and other remedial operations. Depth recorder on the wire line reel indicates number of feet of wire line in the hole, but exact depth of landing is located by "feel" as operator is doing here.

A wireline crewman climbs the gin pole to rig up for cement reversing operation. One-inch aluminum tubing hung below the permanent tubing in the hole is used for this phase of completion. The heavy duty lubricator in the foreground will be installed on the well head when the acidizing operation makes necessary the use of a steel tubing extension. Lines leading from the well head to the pump truck at left carry specially developed cement to the formation. The acid pit is in the background.

perform the workover by conventional methods.

The three cost examples cited do not paint a complete cost-comparison picture. Some permanent completion workovers have been performed for less than these amounts mentioned, some for more. And it is probable that both time and cost will be lowered as field forces become better acquainted with the method. However, the examples do give an indication of what may be expected in future as the permanent completion process is refined and knowledge of it expands. The conventional workover costs cited are in all cases low and do not correspond with average workover costs for any particular field. Thus, comparing actual wireline workover costs with estimated conventional workover costs is deceiving.

Despite this, however, the permanent completion process is showing a decided profit even with these conventional workover estimates.

The independent operator naturally will benefit through savings in original completion costs and the rather high cost of maintaining wells through their productive lives. The amount of savings is generally in direct ratio to the depth of the well. The permanent completion method has been employed in wells to 12,500 feet. Wells have been completed with the equipment to permit wireline workover operations at depths of 13,500 feet. Shallow wells do not effect as high a savings differential as do the deeper wells of 8,000 to 10,000 feet or more. However, since the permanent completion process requires less time to complete a well, it seems desirable to employ it in as many cases as is practicable to take advantage of the saving in drilling rig time.

Since the method permits the removal of the rig prior to the completion stage, a more economical use of rigs may be effected. This factor probably will tend to increase drilling activity and allow more field extensions to be tested and deeper or shallower zones within definitely defined fields to be explored.

Probably one of the most fascinating aspects of permanent well completion methods is that it is tending to open the way for more new developments in drilling practices. In the early days of steam rigs, it was common practice to drill a 12½-inch hole using 6⅝-inch O.D. drill pipe. With the advent of the less powerful gas or diesel rig, hole sizes were reduced to 7⅞ inches or 9 inches, using 3½-inch to 4½-inch drill pipe. Recently, however, large pumps and increased horsepower have started a trend back toward the use of larger drill pipe and greater hole diameters in an effort to improve hydraulic efficiency.[1]

Some drilling engineers feel that this trend will continue and larger holes will prevail. Others, however, are looking in the other direction. Some envision drilling smaller hole diameters and effecting great savings in casing in addition to cementing and other costs.

Many problems must, of course, be solved before such practices can be effected either toward large- or small-bore holes. But the permanent completion process makes such a trend feasible, and perhaps desirable, in any event. Technical problems in equipment design must first be met and satisfactorily solved and much metallurgical engineering work will be necessary before smaller or larger hole diameters will be accepted generally as the most economical size for drilling and producing a well.

Since the introduction of this new completion method to the industry, other major companies besides Humble have performed permanent completions with success. Many independents also have completed wells with the method. Within the Humble company alone, the tubing-type perforator has been used approximately 800 times. On an industry-wide basis, it has been used nearly 2,000 times. Approximately five wireline workovers were performed by Humble in 1952 as development projects. Slightly more than 100 wireline jobs were performed in 1953, only a few of which were for development purposes.

The permanent completion process is still in a trial period in the sense that constant improvements in the method are being made. Many areas that have not seen the application of the permanent completion process will soon be tested. In universal use, the permanent completion method will make possible the rechannelling annually of hundreds of millions of dollars into more directly profitable wildcat and extension drilling.

[1] "Summary of Progress in the Drilling Industry," by Jack Abernathy, *Journal of Petroleum Technology*, September 1953.

Reinterpretation of logging records changes condemned dry holes to producers

By Ruth Sheldon Knowles

HOW MANY WELLS PLUGGED as dry holes were really oil wells?

Every wildcatter has a list of pet "dry holes" which he stoutly maintains would have produced if something hadn't happened or if something else had been done. All these stories can no longer be passed off as sour grapes or wishful thinking. A new exploration technique is demonstrating that as much oil may have been passed up as has been discovered.

During the past five years so many new oil fields have been opened up by this technique in areas supposedly "condemned" by exploration "dry" holes that taking a new look down old holes may become as important as drilling new ones.

The new technique has particularly jolted industry scientists awake because it is not a brand new machine or a startling new principle. Instead, it is the discovery of amazing unrealized powers in one of the industry's most useful and important oil finding aids—electric logging. With mixed chagrin and delight geologists and engineers are discovering that in many cases they have known how to interpret only part of the information which an electric log records. In the pursuit of new exploration techniques they have been like men frantically hunting for their glasses when they were on their foreheads all the time.

No mechanical tool can be any better than the human interpretation of the information it gives. The data necessary to discover millions of barrels of oil is waiting for proper interpretation on even the oldest, simplest and crudest electric logs. Electric logging was first used in the Western Hemisphere over 25 years ago in Venezuela. Two years ago one of the first electric logs ever run was reexamined, reinterpreted and resulted in opening up a new Venezuelan producing area.

At the other extreme, modern electric logs, with some 20 different types of curves instead of only two, have suffered equally for lack of proper interpretation. A typical example is a wildcat drilled to the Wilcox sand at 6,000 feet in Noble County, Okla., only a year ago which was plugged as a dry hole. Recently the electric log was reinterpreted and the old hole reopened to complete a 95-barrel well at 1,750 feet.

"There are millions of barrels of oil lying in old holes waiting for proper interpretation," says Dr. Robert G. Hamilton of Tulsa, the world's leading independent expert in analyzing electric logs, who reinterpreted this Noble County log. "Any field ever drilled that has multiple sands has probably missed oil by the conventional methods of electric log analysis. Furthermore, there are not over 25 percent of the wells drilled today where the electric logs are being evaluated fully."

Dr. Hamilton has been teaching thousands of geologists and engineers what this new challenge is and how to go about meeting it. One of the original four Americans hired by Schlumberger to introduce electric logging to the industry, he resigned as Schlumberger midcontinent manager five years ago to do electric log consulting.

Since then he has been conducting one of the world's most unique schools. Professor and pupils actually open up new oil fields in their classwork. In the first school he taught for Carter Oil Co., the company called in their exploration geologists and engineers from all over the country to attend. Two of them brought for class discussion electric logs of exploration wells in different parts of the country which had been plugged as dry holes. Under Dr. Hamilton's direction the class reanalyzed the logs and reached the opin-

How to turn exploration failures into successes is the reason for such intense absorption on the faces of these Carter Oil Company geologists and engineers as they attend a special school in the art of quantitative electric log analyzing conducted by Dr. R. G. Hamilton of Tulsa, the world's leading independent electric log analyzer.

ion that each well had actually found oil. As Carter had not yet given up the leases, the holes were reentered and completed as producers, opening up two new fields.

The same thing has happened in schools conducted in Venezuela, Mexico, Canada and all over the United States. Practically every major oil company has had Dr. Hamilton deliver a course for their geologists and engineers. In many cases even the executives attend as this new technique is changing exploration thinking.

Groups of independent oil men have gotten together to have special schools set up for them. This new technique opens up a whole new field of opportunity for the independent oil man at a time when exploration chips seemed to be getting so blue that his opportunities appeared to be decreasing. If an independent doesn't have half a million dollars to spend on a 10,000-foot hole or a few millions to bid on tidelands leases, what could be more stimulating than the possibilities of being able to find oil in holes that have been passed up at shallow or relatively shallow depths?

The only thing more stimulating than the possibility is the actuality. As an example, an independent brought an electric log of a "dry" hole in Coleman County, Texas, to Dr. Hamilton. Every oil man can understand the enthusiasm with which he reported the results. "How right you were," he wrote Dr. Hamilton. "We moved in and the sands thickened as per your report and we have drilled 21 wells without a dry hole and are selling 1,344 barrels from the Jennings at 3,400 feet and some wells are still flowing. The sand was 40 feet thick and saturated all the way through."

And what gives an independent operator a greater kick than acquiring leases condemned by a major oil company "dry" exploration test and opening up a new field? One big oil company has been greatly embarrassed as independents, using reanalysis of electric logs, have done just that during the past year in three areas which the company's representatives had pronounced dry.

Dr. Hamilton has been the missionary in this new exploration technique and almost single-handed has been popularizing a science among scientists. He not only has sparked their thinking and shared his research in many classrooms, but he is also the co-inventor of a slide rule calculator, the Arps-Hamilton Log Analyzer, for electric log quantitative analysis, which is being used all over the world.

Today practically every major oil company has an electric logging department or an electric logging specialist. Some companies are beginning to place electric log analysis almost on a par with exploration geology by creating an electric log department head with a specialist in each company division.

Among the major companies giving special attention to electric log analysis research are Shell, Gulf, Texas, Atlantic, Amerada and Sinclair. Shell Oil Co. is particularly aware of its importance as the rich Elk City, Okla., discovery is credited to the reanalysis of electric logs by their specialist after a decision to abandon the area had been made.

Texas Co. is so alert to what has been missed that it has assigned specialists to reexamine every electric log, formation by formation, in the midcontinent area. This is painstaking, systematized oil hunting.

It seems incredible that only now the industry is realizing what electric logs can tell them. But it has been like one of those optical illusions, where you concentrate on one picture and don't realize it

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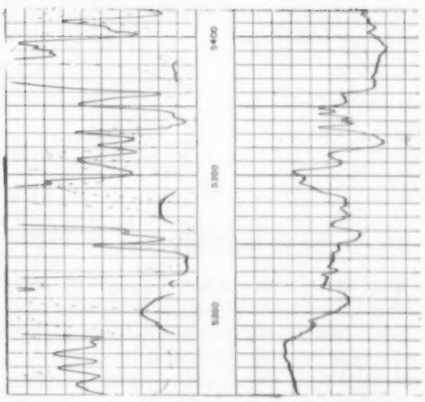


Portrait of a dry hole—or is it? This is a portion of the electric log of an exploration hole plugged in December 1952 after it had been interpreted by conventional methods. About six months later the new exploration technique—quantitative electric log analysis—was applied to this log by expert Dr. R. G. Hamilton of Tulsa, who found a number of potential producing horizons. The hole was cleaned out and pipe cemented. Only one sand was perforated and tested at 5,320-30 feet. Initial production was 50 barrels of high gravity oil per hour.

General view of the site at Ellesmere Port.

Composite chemical group

By E. Lawson Lomax

AT ELLESMERE PORT (Cheshire) in northwestern England a group of specialized chemical plants has come into existence during the past five years. These plants are closely related to the petroleum industry both because their products are widely used by oil companies and because they employ in their own operations elements obtainable from the refineries which have been located in this area.

The origin of this development goes back to 1938 when Associated Ethyl Co. Ltd. was organized to take over the British business formerly handled by Ethyl Export Corporation. In 1940 a British TEL plant was built for the Air Ministry under license and was leased to the British Ethyl Corporation, then jointly owned by Associated Ethyl and Imperial Chemical Industries Ltd. A bromine plant was constructed for the Air Ministry by British Ethyl Corporation under license from Dow Chemical Co. Both these plants were operated during the war by Imperial Chemical Industries for BEC. Following the war British Ethyl Corporation, then owned solely by Associated Ethyl, bought the two government-owned plants which continued to be operated by ICI until the end of 1947 when Associated Ethyl took over.

In 1949, plans were laid for new manufacturing facilities to meet growing demands both for TEL and for providing essential processing materials, the supply of which from other sources was inadequate. The chemicals mainly concerned were sodium, ethyl chloride, ethylene dichloride and bromine. Provision of these requirements has led to the creation of a composite chemical manufacturing center.

After deciding on the site at Ellesmere Port for the tetraethyl lead plant, the problem remained of selecting a site for the production of bromine from sea water. Sea water, although containing only about 67 parts per million of bromine as bromides, is the largest source of this chemical and is the natural source of supply.

A careful survey of the course of the Gulf Stream, with an investigation as to its bromine content and temperature around the shores of the British Isles, indicated that, off the Isle of Anglesey, conditions governing the intake of sea water and disposal of the bromine-weak effluent were generally the most favorable within easy reach of Ellesmere Port, and it was decided to construct the bromine plant on a 23-acre tract at Amlwch on the northern coast of Anglesey. Construction of this plant started in April 1951 and production of bromine began in November 1953.

The factory for the production of tetraethyl lead, sodium, ethyl chloride and ethylene dichloride is located on a 60-acre site at Ellesmere Port, close to the Stanlow refinery of the Shell Refining and Marketing Co. from which the C_2 gases for the production of ethyl chloride and ethylene dichloride are drawn and to which transport for the sodium chloride used in the manufacture is easy from the Cheshire salt-fields.

Construction of this factory started in February 1951 and from May 1, 1954, Associated Ethyl expects to be able to supply all its requirements for tetraethyl lead from this plant.

Incidentally, from the above date, it is proposed to change the brand name

View of part of the works at Amlwch, Anglesey.

at Ellesmere Port-Amlwch

from "Ethyl," which has hitherto been used by Associated Ethyl, to a new brand name, "Octel," for all anti-knock compounds manufactured in Great Britain by Associated Ethyl. The material will be identical with that previously sold under the brand name of "Ethyl," and the change of name is solely for the purpose of identification of the material made in Great Britain.

The manufacturing division of Associated Ethyl, which operates four works —engineering department, research and development department and technical information department—has its headquarters at Ellesmere Port.

The factory for tetraethyl lead is designed and built to make liquid chlorine and sodium from common salt, an amalgam of sodium and lead, ethyl chloride and ethylene dichloride from chlorine and C_2 hydrocarbons, tetraethyl lead from sodium-lead amalgam and ethyl chloride, and finally blend this product with ethylene dichloride, ethylene dibromide, kerosine and dye to give "Octel," the anti-knock compound. It will be seen that it is a comprehensive chemical manufactory.

The process used in the electrolytic plant is the Downs cell, the basic patents on which are held by E. I. du Pont de Nemours. This plant was partly constructed under sub-license from Imperial Chemical Industries Ltd. and partly under direct license from du Pont.

Sodium and chlorine are made by the electrolysis of a molten mixture of sodium and calcium chlorides in Downs cells. The sodium chloride used is of special purity with a very low water content and calcium chloride is mixed with it to lower the melting point of the mass.

A Downs cell consists of a brick-lined steel shell containing four vertical cylindrical graphite anodes, each surrounded by a steel cathode. A steel mesh diaphragm between the anode and cathode prevents the recombination of the products of electrolysis, which is carried out by direct current from a rectifier.

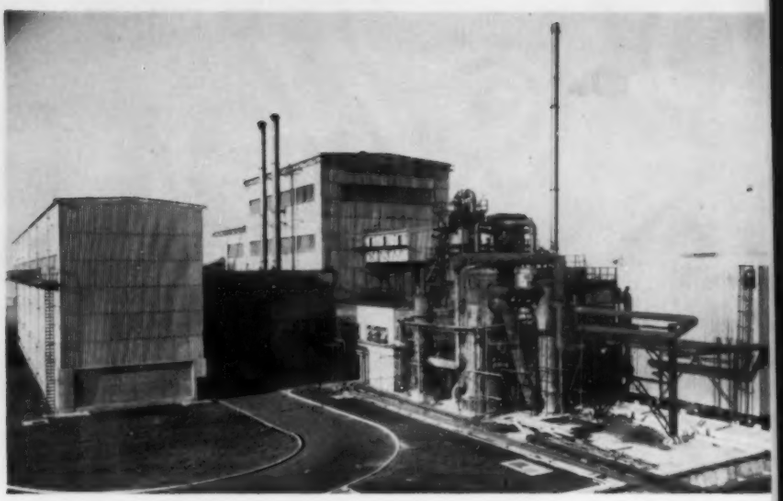
Liquid sodium liberated from the cathode overflows into a receiver and from there is transferred to filters where calcium and other impurities are separated. Purified liquid sodium is conveyed by electrically heated pipe lines to storage. All vessels connected with the manufacture, handling or storage of sodium are blanketed with nitrogen to prevent oxidation of the sodium.

The detailed engineering designs and construction for this plant were carried out by E. B. Badger & Sons Ltd.

In the chlorine liquefaction plant the gaseous chlorine from electrolysis is washed with water and dried with sulfuric acid, and is then liquefied for storage and for separation of any entrained air. The tail gas from the liquefaction still contains a small amount of chlorine which is absorbed by lime slurry. In the event of any breakdown or interruption in the liquefaction plant, provision is made for emergency absorption of the gaseous chlorine from the cells by caustic soda solution. Enough chlorine to satisfy the factory processes is not produced by electrolysis, so additional supplies are brought in from outside sources.

The plant for manufacture of ethyl chloride is based on a new process by Shell Development Co. and is operated under license, the unit being designed by Shell.

Sea water distribution over blowing out tower and connecting duct to absorber at the Amlwch plant.



Sulfuric acid plant and pyrites storage building at Amlwch.

In the first part of the process chlorine reacts directly with ethane, delivered from the Stanlow refinery, to form crude ethyl chloride and hydrochloric acid gas. These are separated by fractionation and the hydrochloric acid gas reacted with ethylene, from the same source as the ethane, to form more ethyl chloride. The crude ethyl chloride is purified by distillation and the almost pure product is stored in Hortonspheres prior to transfer to the tetraethyl lead plant.

Ethylene dichloride is blended with TEL and ethylene dibromide in the motor grade of "Octel," and is produced by reacting ethylene with gaseous chlorine in a stream of ethylene dichloride. The crude product is washed with water and purified by distillation.

The heavy ends from the above distillations, which still contain ethyl chloride and ethylene dichloride mixed with various chlorinated ethanes, are redistilled and the heavier products collected as relatively pure materials available for sale.

Enginering and construction was carried out by The Lummus Co. from designs by BPM, The Hague.

Tetraethyl lead is prepared by the reaction of ethyl chloride with lead-sodium alloy as represented by the equation:

$$4\ NaPb + 4\ C_2H_5Cl = Pb\ (C_2H_5)_4 + 3\ Pb + 4\ NaCl.$$

This lead-sodium alloy is prepared by mixing weighed quantities of molten lead and molten sodium in a jacketed pot to form an amalgam of about 10 percent sodium, heat being evolved during the process. This amalgam is made in 50-ton batches and its composition is very critical as it affects the physical properties of the cooled alloy. Each batch is therefore tested for chemical composition before its passage to the drum flakers. It is cooled on the drums and, when solidified, mechanically combed off, its physical condition at this stage controlling the size and texture of the flakes combed off. From this machine it is filled into portable steel hoppers to the definite weight required for each batch in the TEL plant.

The lead used in this stage is mainly of Australian origin. It is melted in electrically heated pots and then pumped in batches by pumps submerged in the molten lead through electrically heated pipe lines to the alloy plant.

All the vessels in this plant containing sodium or alloy are nitrogen blanketed to prevent oxidation. The nitrogen used is made at the works by burning hydrogen in air to remove oxygen.

The resultant gas is then scrubbed to remove carbon dioxide, dried, compressed and delivered to storage tanks in the consuming areas. Hydrogen is supplied by pipe line from the Stanlow refinery, but in the event of a failure in supply, hydrogen can be produced in a stand-by plant from anhydrous ammonia in ICI standard cracking units.

In the "Octel" blending plant, TEL, ethylene dibromide, kerosine and dye are blended to produce the anti-knock compound.

The motor blend contains all these ingredients and a yellow dye is used, but the aviation blend does not contain ethylene dichloride and a blue dye is used for identification purposes.

Weighed quantities are mixed in batches in the blending vessels and each batch is subjected to tests to meet a rigid specification.

The product is then filtered and run into bulk storage tanks, from which it is filled into 45-gallon drums for general distribution.

Erection of the plant was carried out by The Lummus Co. The main civil engineering contractors were George Wimpey & Co. Ltd.

At the Amlwch works the process employed consists of displacing the bromine in its salts by chlorine, driving off the released bromine by air, separating it as hydrobromic acid and releasing it by treatment with chlorine and collecting the bromine as a liquid. About 80 percent of the bromine contained in the matter is recovered, but owing to the extremely dilute solution, enormous quantities of water have to be treated.

The sea water enters the factory through a tunnel driven several hundred feet through solid rock to the pump house. From there it is pumped to a reservoir from which it flows to the blowing-out tower. The pumps installed for this purpose are two of 30,000 gpm each and one of 50,000 gpm. Screens are installed to take out any sea-weed, debris or other solid contents of the water.

Extraction takes place in the blowing-out tower and absorber. As the sea water flows to the tower, a mixture of sulfuric and hydrochloric acid is added to maintain the pH value at 3.5 in order to prevent hydrolysis during bromine liberation. This acid is added by centrifugal pumps, the pH value controlling the amount of acid fed in by the pumps so as to maintain a constant pH value in the treated sea water. Chlorine gas is then passed in to release the bromine from the sodium bromide present in the water.

The treated water then passes through the blowing-out tower as a thin film over ceramic Raschig rings, through which air, induced by fans at the top of the absorber, flows in counter current. The effluent water, stripped of 80 percent of its bromine content, then flows from the bottom back into the sea at a safe distance from the intake.

The air carrying bromine then passes

to the absorber and in its passage is treated with sulfur dioxide and water, and a fine mist of hydrobromic and sulfuric acids is formed. This mist is passed through water-irrigated glass fiber filters in the absorber and the mixed acids together with a little hydrochloric acid are collected as absorber liquor. It contains about 10 percent of bromine as hydrobromic acid.

The absorber liquor is then treated with chlorine, whereby bromine is liberated from the hydrobromic acid. The treated liquor is then steam distilled in steaming-out towers to drive off the free bromine, which then passes through condensers, separators and dryers and is collected as liquid bromine.

The effluent from these towers, containing sulfuric and hydrochloric acids, is returned to a dilute acid tank for use in the acidification of virgin sea water entering the blowing-out tower.

The bulk of the liquid bromine obtained is used for the manufacture of ethylene dibromide, a certain small amount being sold as such for use in various chemical processes.

Ethylene dibromide is made in batches by bubbling ethylene gas into liquid bromine. This reaction is highly exothermic, and so extensive water cooling has to be employed to control the rate of reaction and prevent loss of bromine and ethylene. The crude dibromide is slightly acidic and is therefore treated with sodium carbonate solution to neutralize it, the alkali washings being returned to the steaming-out tower when almost neutral, where any absorbed bromine is recovered.

Ethylene dibromide, owing to its high specific gravity, is readily separated from the washing liquor, and is then passed to storage for delivery to the tetraethyl lead plants. The ethylene used in this process is received in road tank cars and stored as liquid in stock tanks.

A stand-by plant is available for making ethylene from ethanol, by cracking in presence of a catalyst, should supplies of liquid ethylene be interrupted for any reason, thus assuring constant use of the produced bromine.

Sulfur dioxide gas is made from pyrites in a flash roaster. The use of pyrites for this purpose is far from ideal, and in this process there is little or no use for the roasted ore, but owing to the shortage of elemental sulfur this material has to be used.

Part of the sulfur dioxide produced is used directly in the absorber and the other part is converted to SO_3 by passage over a vanadium catalyst, with the ultimate formation of sulfuric acid for use in the blowing-out tower.

One of the major problems in connection with this works is that of corrosion, as from the virgin sea water to the liquid bromine all the process materials are highly corrosive. All of the steel operating plant has to be protected by rubber or plastics, while the pipe lines have to be ceramic or glass, or where mechanical strength is required, steel or cast iron pipes have to be ceramic lined.

The whole of the rubber-cladding of the metal work was done by the Dunlop Rubber Co., and is probably the largest job of this kind ever carried out. The technique for covering the various portions had to be altered and devised on site, as the separate sections were too large to be covered in the Dunlop works.

Another important consideration is the prevention of leaks of chlorine, bromine or sulfur oxides into the atmosphere.

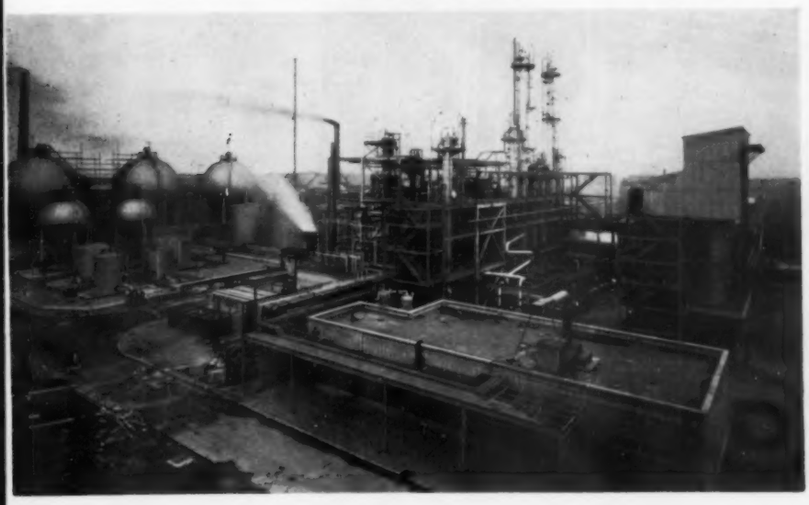
At the time of the writer's visit these problems seemed to have been attacked very successfully, and great credit is due to all concerned for successful solution of a difficult problem.

The factory is well laid out with ample provision for extensions as and when required and the housekeeping is of the highest order.

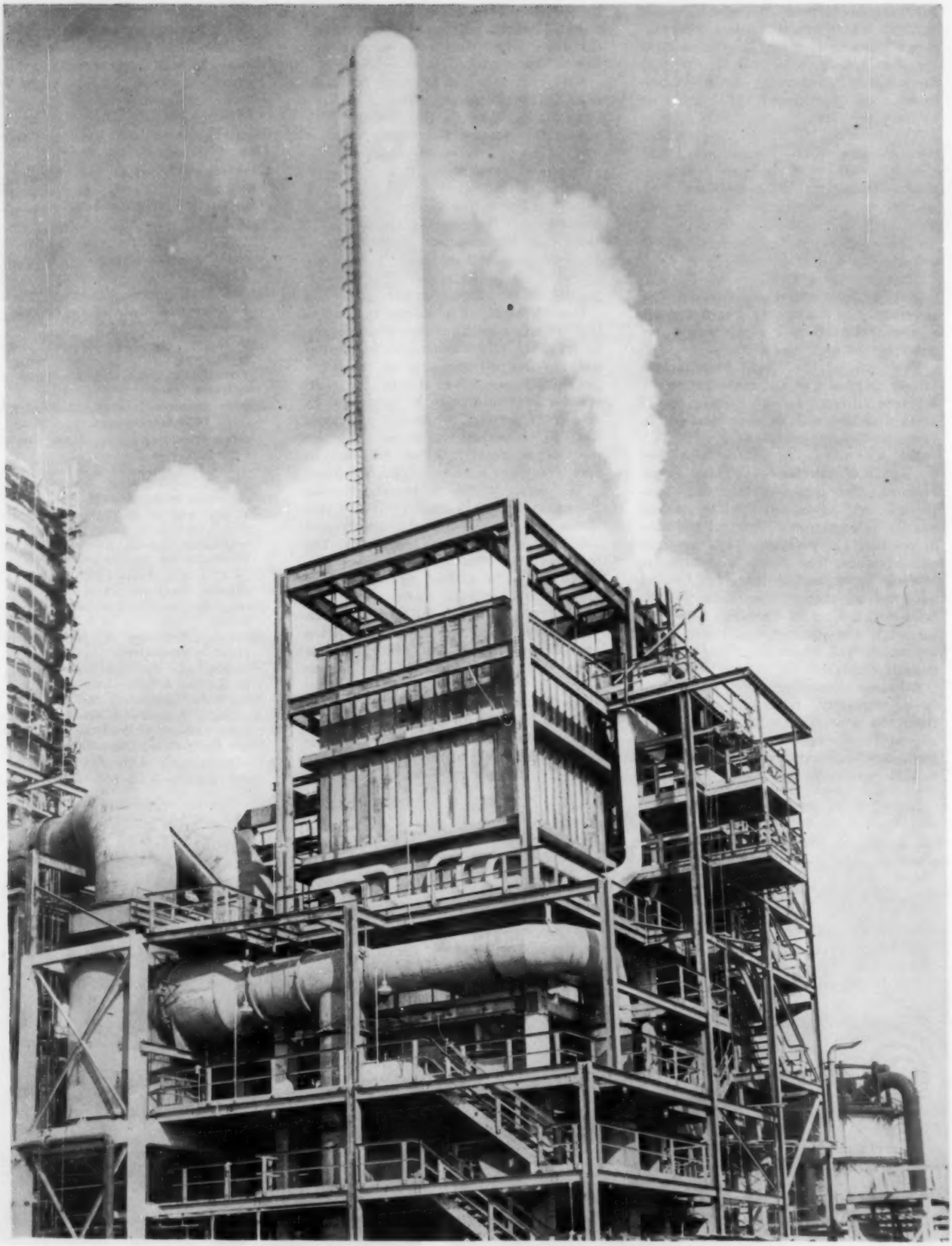
All civil engineering design and construction has been undertaken by the company's civil engineering consultants, Messrs. Maunsell, Posford & Pavry, in collaboration with Sir Alexander Gibb and Partners. Associated Ethyl engineered all the process plant and services. The civil engineering contractors were Marples, Ridgway & Partners. Some of the principal contractors engaged in construction of the plants were as follows:

Simon-Carves Ltd.—Sulfuric acid plant.
Head Wrightson Process Ltd.—Standby ethylene plant.
I.C.I. Ltd.—Nitrogen plant.
John Thompson Water Tube Boilers Ltd.—Boiler plant.
Dorr-Oliver Co. Ltd.—Effluent treatment plant.
Carrier Engineering Co. Ltd.—Drum reconditioning plant.
British Thomson-Houston Ltd.—Site sub-stations, high tension gear.
Vickers-Armstrong Ltd.—Main sea water process pumps.
The Fairfield Shipbuilding & Engineering Co. Ltd.—Bromine plant absorption tower, sea water main, tankage.
Matthew Hall & Co. Ltd.—Piping and instrumentation.
Metropolitan-Vickers Electrical Co. Ltd.—Electrical low tension switchgear.
D. & C. & Wm. Press Ltd.—Erection of mechanical plant and piping.
Dunlop Rubber Co. Ltd.—Extensive rubber lining.
Mirrlees, Bickerton & Day Ltd.—Diesel stand-by generators.
Whessoe Ltd.—Spherical holders.
Wm. Kenyon & Sons—Insulation.
Sotos Ltd.—Laboratory furnishings.
Automatic Telephone & Electric Communications Systems Ltd.—Automatic telephones.
Peter Brotherhood Ltd.—Turbines.
L. Sterne & Co. Ltd.—Refrigeration plant.
Robert Jenkins & Co. Ltd.—Tanks.

General view from the west side of the chlorination group at Ellesmere Port.



Sodium building and chlorine plant auxiliaries, Ellesmere Port.



CO boiler and steam superheater improve fluid cat efficiency

By O. F. Campbell and N. E. Pennels

Acknowledgement

The writers wish to thank the following engineers for their assistance in original design, drawings, photographs, construction and operation of the CO boiler and the respray steam superheater:

C. F. Braun & Co.: H. S. Spaulding, M. Bason and J. Bowen.

Babcock & Wilcox Co.: F. S. Nolte, C. L. Marques, E. H. Manny, E. Durham, L. W. Hayward, J. Knoblesdorf and L. G. Troutman.

Sinclair Refining Co.: W. S. Gulette, H. C. Kuhn, W. H. Decker, D. A. Stewart, R. S. Cooper, R. Y. Rankin, and W. F. Shippani.

APPROXIMATELY 400,000 pounds per hour of 550 psig, 750°F total temperature steam production is a unique feature of Sinclair Refining Company's new fluid catalytic cracking unit at its Houston refinery.

Over 300,000 pounds per hour of 700 psig saturated steam is produced on the oil industry's first direct-fired unit to recover both the sensible heat and the heat of combustion from the high temperature regenerator exit flue gas. The heat of combustion of the regenerator exit flue gas is derived from its CO content. Saturated steam produced on the boiler is superheated to 750°F total temperature in industry's first fluidized bed respray steam superheater. The superheater respray feature produces approximately 100,000 pounds per hour of additional steam and allows simultaneous control of both the regenerator bed temperature and the steam superheat.

Sinclair fluid units have all been of the non-heat balance type to insure better product distribution and more flexible control of cracking conditions. Previous fluid unit installations have included extensive arrangements for recovery of waste heat, but without burning CO.

The heat input to the waste heat boiler at Houston comes from the sensible heat and the carbon monoxide heat of combustion of the regenerator exit gases, and from supplementary fuel required to burn the CO to CO_2.

The respray steam superheater is immersed in the fluidized bed of the regenerator to superheat the steam from the waste heat boiler and to control the fluidized bed temperature. It is called a respray steam superheater because the steam can be superheated and desuperheated as it passes through the superheater for greater flexibility of heat removal from the regenerator fluidized bed. Since the steam production from the CO boiler and respray superheater is greater than that required to turbine drive all pumps and blowers, the fluid unit and the CO boiler are entirely free from upsets in outside sources of steam and energy.

As in any combustion process, complete combustion in a fluid catalyst regenerator is primarily a function of time, temperature, turbulence and excess oxygen. The catalyst is an added factor which retards complete combustion. However, the primary factor leading to CO production is the low regenerator bed temperature. It must be remembered that the regenerator is designed primarily to restore the cracking activity of catalyst by burning off the coke. Since cracking catalyst is deactivated by sintering at high temperatures, the regenerator temperature is usually limited to 1,100°F for synthetic catalyst and 1,070°F for natural catalyst. Excess oxygen is ordinarily very low due to the cost of compressing the regenerative air to about 20 psig. This factor would make it highly desirable to have an even higher CO production since CO_2 requires twice as much oxygen as CO.

The main problem in developing a waste heat boiler to recover the combustion heat of the CO regenerator flue gas was to establish whether there were economical conditions of time, temperature, turbulence and excess oxygen at which approximately 15 Btu/cu. ft. CO-bearing gas would complete combustion. Due to the low CO content, it was realized that thorough mixing with air at a temperature higher than that of the gas available from the regenerator was required.

The problem was investigated using a small pilot unit installed on Sinclair's fluid unit at Marcus Hook. The pilot unit was designed to raise the temperature of the flue gas by firing auxiliary fuel gas with sufficient excess air to supply excess oxygen to the CO gas. A vane wheel insured intimate mixing of the CO gas and the auxiliary fuel and air. Operation of this pilot unit proved that the CO bearing gases could be completely burned with 10 to 20 percent excess oxygen in the exit flue gas and thorough mixing at a temperature of about 1,450°F.

For the construction of the CO boiler built at Houston, C. F. Braun & Co. was chosen as the prime contractor for the fluid unit and The Babcock & Wilcox Co. was the CO boiler manufacturer.

The CO boiler consists essentially of a pressurized primary cylindrical refractory furnace and a secondary water-cooled furnace with an economizer. It includes a bypass arrangement so that the boiler may be shut down without shutting down the fluid unit.

Final design of the primary furnace

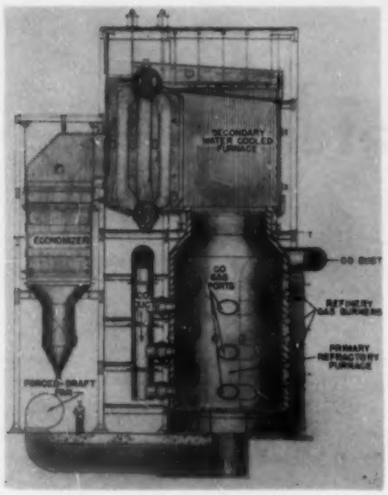


Figure I: Construction diagram of Sinclair Refining Co. CO boiler at Houston, Texas.

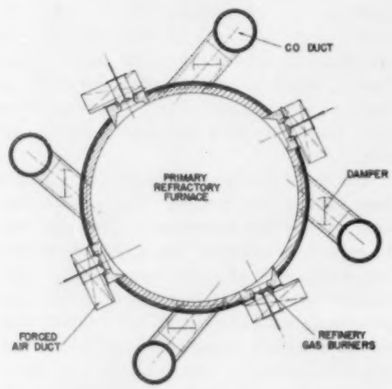


Figure II: Plan view of primary furnace.

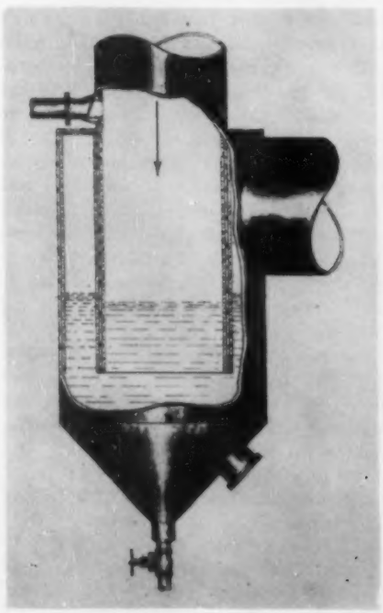


Figure III: Seal tank.

was a cylindrical refractory furnace designed for operation up to 2,500°F. This high temperature was selected so that the boiler could be fired with high excess air to produce 220,000 lb/hr of steam with no CO gas for the startup and shutdown periods of the fluid unit. CO gas was injected through 12 tangential inlet ports symmetrically located with four ports at three different levels. Twelve auxiliary fuel burners were symmetrically located with four burners at each of three levels. The top level of burners was located above the top level of CO ports so that the CO bearing gas would have to pass through a top level of fire to leave the primary furnace.

The secondary furnace is a conventional water tube single pass boiler. The arrangement of the top-supported secondary furnace required a water seal to provide for the downward expansion of the secondary furnace and the upward expansion of the primary furnace. The seal is shown in Fig. I.

To insure continuous operation of the fluid unit, a CO gas bypass system was designed. Fig. IV shows that the CO gas from the regenerator may pass through a water seal tank to the boiler or through a bypass seal tank directly to the stack. Fig. III is a drawing of a seal tank with the water seal established. When the water is drawn out, the CO gas passes down through the internal pipe, up the annular space and out the side duct. A multi-vane damper (not shown) is installed above the seal pot to provide partial closure so that the water seal may be established. The small pipe off the side of the inlet duct was provided to bleed off the gas bypassing the damper and make the water seal easier to establish. Operation has shown that it was not required.

All controls for the CO boiler are located at the fluid unit main control panel. The boiler feed pumps are pressure-controlled by throttling the turbine steam, with provisions for starting up and shutting down either pump from the board. The pumps are protected from low flow seizing by automatic low flow recirculation. The controls include three-element feed water control and automatic combustion control of the auxiliary fuel and air to control the primary furnace temperature. The boiler feed pumps and the forced draft fan are turbine driven and the controls are pneumatic to make operation free from power failures.

Tables I and II summarize four performance tests made on the CO boiler during November 1953. The data shows that 320 million Btu/hr or 74.5 percent of the heat input is waste heat.

There were several interesting developments in the initial operation of the CO boiler. The tangential entry of the CO gases produced the desired mixing as evidenced by the complete combustion of the CO at 1,800°F with 2.6 percent oxygen in the flue gas. The swirling action was more pronounced than expected, producing a cyclonic effect which increased the pressure at the face of the furnace to as much as eight inches of water pressure above the pressure in the center of the primary furnace. The pressure in the center of the primary furnace was three to four inches of water pressure less than the pressure in the secondary furnace. The turbine-driven forced-draft fan had to be speeded up to provide the static pressure to force the auxiliary air through the cyclonic wall of gases.

During the design stages it was decided that catalyst fines would collect on the boiler tubes, so 12 I.K. retractable soot blowers were installed, eight in the boiler passes and four in the economizer. The soot blowers have been thoroughly successful in keeping the tubes clean when used on a once-per-shift cleaning schedule. There has been no collection of catalyst fines in the primary furnace.

Control of the CO boiler has been very easy. Automatic control of the primary furnace temperature has, however, proven unnecessary. The quantity, temperature and CO content of the regenerator flue gas are so consistent that the primary furnace temperature does not have enough variation to permit automatic control. As a result, boiler operation to date has been on manual control. High and low temperature alarms are provided to warn of abnormal conditions.

Prior to the decision to install the respray steam superheater in the regenerator fluidized bed, a one-inch water-cooled bayonet was inserted into the fluidized bed of an existing fluid unit. The quantity of circulating water was weighed, the water temperature rise was taken, and with a known heating surface and the temperature of the fluidized bed, a heat transfer rate was established which was reasonably close to the data available in the literature.

Before operating the Houston respray steam superheater, Sinclair had obtained valuable experience in the operation of a forced circulation boiler with the heating surface immersed in the regenerator fluidized bed at its Wood River, Ill. refinery. Fig. B shows the general arrangement of the Wood River forced-circulation boiler equipped with ten coils having a total heating surface of about 600 square feet. Heat absorption rates of approximately 50,000 to 60,000 Btu per sq. ft./hr. have been obtained with a temperature differential of approximately 700° F. The heat extraction can be controlled by only 10 percent increments by cutting coils in or out of service, one coil at a time. At the end of one year's continuous service, no repairs were required.

Just as the CO boiler is a "first," so is the method of controlling the fluidized bed temperature by superheating

(Please turn to page 90)

TABLE I

CARBON MONOXIDE BOILER

Test Data

Test Number	1	2	3	4
CO Bearing Gas				
Quantity M Lbs/Hr	650.4	650.9	679.2	678.6
Temperature °F	990	990	993	993
Composition Mol %				
Carbon Dioxide	8.2	8.1	7.8	7.8
Carbon Monoxide	4.8	4.8	4.7	4.9
Oxygen	4.5	4.5	4.5	4.5
Nitrogen	67.5	67.4	67.7	67.8
Water Vapor	15.0	15.2	15.3	15.0
Total	100.0	100.0	100.0	100.0
Auxiliary Fuel (Natural Gas)				
Quantity M Lbs/Hr	4.75	4.75	4.63	4.63
Temperature °F	73	76	78	80
Higher Heating Value Btu/Lb	23,186	23,178	23,391	23,351
Auxiliary Air				
Quantity M Lbs/Hr	108.0	103.7	106.7	111.4
Moisture M Lbs/Hr	1.6	1.5	0.5	0.7
Temperature °F	72	74	66	66
Flue Gas				
Quantity M Lbs/Hr	764.75	760.85	791.03	795.33
Temperature °F	503	511	530	530
Composition Mol %				
Carbon Dioxide	12.3	12.3	12.0	12.0
Carbon Monoxide	0.0	0.0	0.0	0.0
Oxygen	2.6	2.5	2.6	2.7
Nitrogen	69.6	69.5	69.9	70.0
Water Vapor	15.5	15.7	15.5	15.3
Total	100.0	100.0	100.0	100.0
Primary Furnace Temp. °F	1815	1825	1775	1775
Primary Furnace Press. "H_2O	13.1	13.1	13.1	13.0
Steam (Saturated)				
Quantity M Lbs/Hr	305.7	303.9	315.0	313.2
Pressure psig	710	710	715	710
Boiler Feedwater				
Quantity M Lbs/Hr	330.0	328.0	340.0	338.0
Temperature °F	235	235	235	235

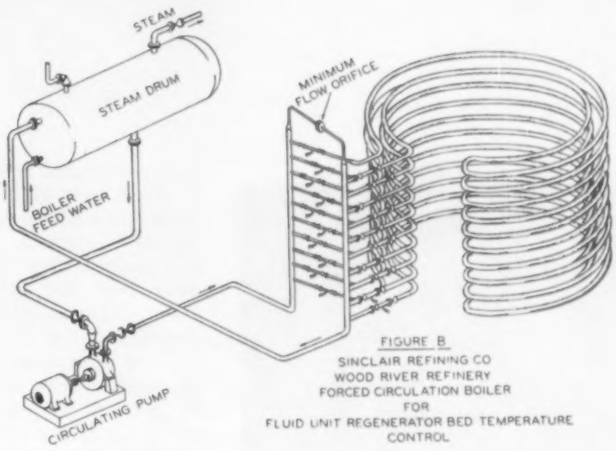


FIGURE B
SINCLAIR REFINING CO
WOOD RIVER REFINERY
FORCED CIRCULATION BOILER
FOR
FLUID UNIT REGENERATOR BED TEMPERATURE CONTROL

TABLE II

CARBON MONOXIDE BOILER

Test Heat Balances Million Btu/Hour Datum: O°F

Test Number	1	2	3	4
Gas Side Heat In				
CO Bearing Gas				
Sensible Heat	175.26	175.38	183.95	183.53
Combustion Heat	135.40	137.60	141.39	144.09
Auxiliary Fuel				
Sensible Heat	0.16	0.17	0.18	0.18
Combustion Heat	110.16	110.12	108.28	108.09
Auxiliary Air				
Sensible Heat	1.93	1.90	1.69	1.77
Total	422.91	425.17	435.49	437.66
Heat Out				
Flue Gas	113.18	114.34	122.42	123.76
Radiation (0.5%)	2.11	2.13	2.18	2.19
Total	115.29	116.47	124.60	125.95
Total Heat Absorbed	307.62	308.70	310.89	311.71
Steam Side Heat In				
Feedwater	67.08	66.68	69.12	68.72
Heat Absorbed	312.00	309.90	321.47	319.62
Total	379.08	376.58	390.59	388.34
Heat Out				
Steam	367.02	364.60	378.16	376.03
Blowdown	12.06	11.98	12.43	12.31
Total	379.08	376.58	390.59	388.34
Total Heat Absorbed				
Gas Side	307.62	308.70	310.89	311.71
Steam Side	312.00	309.90	321.47	319.62
Difference	4.38	1.20	10.58	7.91
Percent Difference	1.4%	0.4%	3.3%	2.5%

TABLE III

FLUIDIZED BED RESPRAY STEAM SUPERHEATER

Test Data

Test Number	1	2	3	4
Steam to Superheater				
Quantity M Lbs/Hr	305.7	303.9	315.0	313.2
Pressure psig	710	710	715	710
Temperature °F	507	507	508	507
Respray Condensate to Superheater				
Quantity M Lbs/Hr	81.0	87.0	94.0	87.0
Temperature °F	235	235	235	235
Superheated Steam				
Quantity M Lbs/Hr	386.7	390.9	409.0	390.2
Pressure psig	540	540	540	540
Temperature °F	750	750	755	760
Total Heat Absorbed				
Million Btu/hr	150.9	157.6	169.1	161.6
Regenerator Bed Temp. °F	1067	1066	1059	1058
Log Mean Temperature Difference °F	362	368	386	365
Effective Surface Ft.²	6000	6000	6000	6000
Overall Heat Transfer Rate Btu/hr/ft.²/°F	69.3	71.3	72.8	73.7

LEGEND

TRT - TEMPERATURE RECORDING TRANSMITTER
TIC - TEMPERATURE INDICATING CONTROLLER
HTA - HIGH TEMPERATURE ALARM
FR - FLOW RECORDER
PI - PRESSURE INDICATOR
○ - LOCAL MOUNTED INSTRUMENTS
⊖ - BOARD MOUNTED INSTRUMENTS

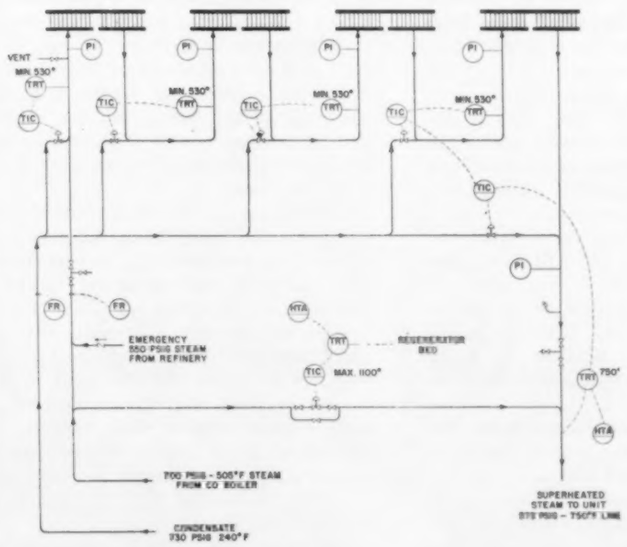


Figure VI: Schematic flow diagram of respray steam superheater.

Creole's gas injection plant called world's largest

By Dr. Federico G. Baptista*

CREOLE PETROLEUM CORPORATION is presently building a large plant to inject gas into one of the largest oil deposits of the Bolivar Coastal field, an operation that will be the largest of its kind in the world. The gas passing through this great plant will be injected into a single oil deposit in Lake Maracaibo basin, in Creole's Tia Juana district, and the gas compression plant will be constructed on a platform seven miles from the shore.

The deposit to be treated is composed of three sections, divided by faults, on the B-6-X Eocene sands. Since faults do not impede free flow of fluids in the subsoil, the three fragments constitute a single body of approximately 9,800 acres.

The net sand width is approximately 170 feet. The sands themselves are highly porous and have excellent permeability. The structure is monoclinal, with a 3-degree inclination angle. It disappears against an unconformable, post-Eocenic structure. The deposit is limited by faults on its borders, and at the bottom of the structure by an apparently stable water level. The top of the sands is approximately at 5,250 feet.

The deposit was discovered by Creole in 1939, when drilling well LL-370. The name of this well was used for the new oil deposit. In fact, when it was drilled, the well was located five kilometers away from the nearest producing area, and was the discovery well to the Eocene production in this part of the Bolivar Coastal fields. In 1940, another well was drilled, but the real development of the deposit began in 1941 when five additional wells were drilled. Development work continued throughout the years, and by the end of 1951 a total of 49 wells had been drilled.

Characteristics of these Eocene sand deposits permit production at relatively high rates, and at present the average production per well can be efficiently maintained at 1,200 barrels per day. Since the beginning of 1946 the deposit has produced in the neighborhood of 50,000 barrels daily.

This deposit is similar to all those of major extent in the Bolivar Coastal fields in two very interesting characteristics, from a technical standpoint: (1) it has no water pressure in the bottom, and (2) it originally had no gas cap at the top. Under normal production conditions, energy for the production is obtained from gas in solution, by gravity drainage and by secondary gas expansion.

Gravity of the crude varies from 18° API in the bottom to 28° API in the top. The average gravity is approximately 25° API. This crude oil is similar to other crudes from the Bolivar Coastal fields, but its gravity is lower and has a higher viscosity than most crude oils from the United States.

At 5,235 feet under water level, the original pressure in the deposit was 2,590 pounds per square inch and, although the deposit had not been water-flooded, pressure decreased only to 1,740 pounds per square inch by the end of 1951. By that date, accumulated production of the deposit totalled 140,000,000 barrels. This natural accumulation of oil had been efficiently maintained through a constant vigilance over the gas-oil ratio; in other words, obtaining production of every barrel of oil while using the least possible gas.

During the development of this deposit, the importance of obtaining cores from the productive sands of the subsoil fluids was fully realized, and in many wells cores were obtained throughout the productive formations. Characteristics of porosity, permeability and saturation were determined. While the deposit was being developed, all properties of the sub-soil fluids were checked to obtain accurate data on the oil characteristics. Analysis of all this information was the initial step undertaken four years ago. In view of the complications of several variations in the producing sands' characteristics and in the fluid's contents, estimation of the recoverable oil under several development methods required 10 man-years of work.

Behavior of the deposit in future years was estimated under three different conditions: (1) production by natural forces, (2) production by maintenance of pressure with gas injection, and (3) production by maintenance of pressure through water injection. This analysis indicated that gas injection was the most advantageous method and it was decided to build a plant with a daily capacity of 130,000,000 cubic feet. Maintenance of gas pressure in the deposit will conserve the total volume of fluids produced in future.

The plant is being built on a platform in Lake Maracaibo where water depth is approximately 62 feet. Construction of the platform and vibration of the compressors and motors presented serious

* District Superintendent Caripito, Creole Petroleum Corp.

problems. To reduce vibration it was decided to use a centrifugal installation. The plant will inject gas at approximately 1,935 pounds per square inch and will have a capacity of 2,000 pounds per square inch at the compressor head. Since no centrifugal compressor had previously been constructed to deal with more than 1,000 pounds per square inch, it was necessary to design special machinery for this purpose. This engineering project was undertaken by Ingersoll-Rand Co. Besides the special design, the company is also constructing 10 compressors to be used on seven compression stages.

The first stage will utilize three compressors; two more will be used on the second stage; and the third, fourth, fifth, sixth and seventh stages will use one compressor each. The plant will have a capacity of 137,000,000 cubic feet per day, of 7,000,000 more than was considered necessary after the technical analysis. Each of the 10 Ingersoll-Rand compressors will be powered by a General Electric 6,000-horsepower gas turbine. Several gas turbines of this kind are in use, but LL-370 will be the greatest concentration of gas turbines in actual use. These turbines will utilize gas from the second compression stage.

Brown & Root Co. of Houston has had charge of the design and construction of the plant. Piles for foundations have been assembled and have been driven to the lake bottom. The platform and building have also been completed. If construction continues at normal speed, it is expected that the plant will start operation within the next few months.

Gas for the plant will be collected from eight flow stations located near the compressor plant. These stations must operate on low pressures to avoid a decrease in oil production and therefore the gathering lines have a 30-inch diameter. Design and location of a large-diameter collecting system on the bottom of Lake Maracaibo is in itself a noteworthy engineering achievement. It is interesting to note that besides covering the pipe lines with cement to avoid flotation, a special device was necessary to empty the pipes in case of any filtration. This was necessary because the water pressure outside the lines will be greater than the gas pressure inside. In event of a breakdown, the lines will be flooded with water instead of permitting gas to escape into the lake.

To study effects of the gas injection, carbon monoxide will be added to the gas returning to the subsoil. The deposit engineers will make periodical studies of the producing wells to determine the presence of carbon monoxide and thus it will be possible to estimate the displacement efficiency and control expansion of the secondary gas cap.

As a consequence of the gas compression, condensation of natural gasoline in the plant's cooling system will be obtained. This natural gasoline will be separated in a special separator and then will pass through a stabilizing drum. Then it will be pumped to the collecting stations and will be added to the crude oil. No gasoline will be stored at the compressors' plant platform.

It is believed that the plant will be very efficient, contributing to the welfare of the company and of the nation. Besides increasing by 33 percent the total recoverable oil above the normal production, it is anticipated that gas injection will increase producing rates of the deposit by approximately 50 percent. By pressure maintenance, the use of pumps and other artificial lifting equipment will be avoided in future years.

Gas injection is also advantageous if compared with water injection, for it eliminates totally the problem of separating water from oil. Finally, from the conservation viewpoint, the deposit of 130,000,000 cubic feet of gas for future years contributes to the most advantageous use of Venezuela's petroleum resources.

Two views of the construction area LL-370, Lagunillas, where the gas compression plant will be constructed.

Rocky Mountain region sees broader activity

By Tom Dougherty*

OIL EXPLORATION AND DEVELOPMENT in the Rocky Mountains reached the highest level in its history during 1953.

The establishment of new records in practically all phases of the petroleum industry's operations in the region was a partial maturing of trends which have been apparent in the post war years. For the first time the region was linked to major markets adequately enough to make its influence felt through all segments of the industry and in all areas.

During the past year a total of 1,037 wildcats were drilled in the Rockies, resulting in 144 discoveries. Thus, 13.88 percent of Rocky Mountain exploration was successful. This is almost exactly one successful wildcat in seven, a considerably better average than is enjoyed by the industry as a whole.

Increased drilling in the region, rather than being more sparsely rewarding, has had an increasing amount of success. Wildcats drilled in 1953 increased by 31.2 percent over the previous year. Yet the number of discoveries jumped by 48.4 percent, advancing the region's overall success ratio by 1.61 percent.

Well completions during the year were 3,417, a gain of 1,060 over the previous year, which had set an all time record to that point of 2,357 completions. The rather substantial increase for both years was greatly aided by increased development, particularly in Wyoming.

Production in the region increased by nearly 30 million barrels during 1953, moving from just over 113 million in 1952 to nearly 143 million last year. The bulk of this increase came in Wyoming, which produced 82½ million barrels in 1953 as compared with 68 million the previous year. Substantial increases were registered by nearly all states of the region with the exception of Utah and northern New Mexico, where the influence of a new outlet (the Platte Pipe Line) was not noticeable. North Dakota's increase of nearly four and three quarter million barrels was especially important in view of the state's short production history.

Completion of the Platte Pipe Line from Wyoming to Wood River, Ill., and of two shorter tributary systems serving the Denver-Julesburg basin of Colorado and western Nebraska made the production increase possible. The Platte began operations in late 1952 and reached capacity of slightly more than 100,000 b/d by July 1953. By that time decision to add two pump stations to increase capacity to 145,000 b/d had been made.

Increased development and exploration brought about by the construction of the Platte kept 250-300 rotary rigs busy in the Rockies throughout the year. For the first time the active rotary count rose above 300 and activity was maintained at the 300-plus level for a considerable time during the summer months.

Long-term recognition of the region coincided with the strikes made in production and exploration. Some judgement of present thinking on Rocky Mountain futures may be gained from the fact that two major operators established offices with regional autonomy. Shell Oil opened an area office in Denver with status equal to the Tulsa or Los Angeles offices from which the Rockies had been previously administered.

Socony-Vacuum completed establishment of its Pegasus division, charged with Rocky Mountain operations previously handled by its subsidiaries, General Petroleum and Magnolia Petroleum. Both these companies retained operations in parts of the Rockies, but Pegasus, with offices at Billings, took over operations of the major portion of the region for Socony.

General Petroleum is one of the long-term operators in the Rockies, having been active long before the current high-level exploratory campaign which had its beginning in the immediate post war period. Shell, however, had done only

Seismograph crews in the Rockies find scenery the average tourist never gets close to . Here a shot is set off in Glacier County, Montana amid ruggedly impressive surroundings. Shell photo.

* Staff writer, *Petroleum Information.*

reconnaissance work in the region during the 30's and entered the area as a large scale operator only a few years ago. Shell, Socony-Vacuum and other majors, plus the many smaller operators who have located regional offices or entire headquarters in the Rockies, have done so with the expectation of programs sufficient to insure continued heavy exploration for several years.

A number of significant developments may be listed for 1953 in exploration as well as general development of the Rockies. A great many of these represent the attainment of objectives which have been pursued for some time and will have more than routine effect on future work.

Potentially the most important development since discovery of oil in the Williston Basin came early in 1954 when Shell Oil reported a successful wildcat in Nevada. The company's No. 1 Unit, in the Eagle Springs area of Nye County, 65 miles southwest of the town of Ely, recovered oil from an unidentified formation at about 6,500 feet.

Cores and tests from 6,453 to 6,970 feet had recoveries of oil and continuing shows.

Even though the well was not completed, a rush of leasing began late in February. The federal land office at Reno was inundated with applicants for leases on federal lands. Geophysical and surface geological parties were moved to the state by many operators, and reports at the end of the second week of March indicated that the play in the state was just beginning.

Major companies with previous holdings include Continental Oil, Standard of California, Gulf and Sinclair.

Cores in the Shell well recovered largely volcanics and geological problems were multiplied by the apparently commercial discovery.

Nevada's more favorable situation with respect to unsaturated markets brings even more immediate pressure for development than was felt in the Williston Basin. The Basin and Range province in which the discovery is located covers western Utah, practically all of Nevada and parts of Arizona and Idaho. The large area opened to exploration by Nevada's first discovery is another convincing factor in the observation already noted that this may be the Rocky Mountain area of most significance in 1954.

In the Williston Basin, the largest and most widely publicized of Rocky Mountain basins, albeit the newest from an exploration standpoint, the major developments of the year came in the form of successes on seismic prospects. Despite the fact that the area is very heavily prospected by geophysics, discoveries were confined to surface expressed structures prior to 1953.

The first such discovery was by Sun Oil and Phillips Petroleum on a jointly-controlled block northwest of the town of Sidney, Richland County, Montana. This well found production in Ordovician between 12,585-12,605 feet, and was completed for 745 barrels of oil per day through 20/64 inch choke.

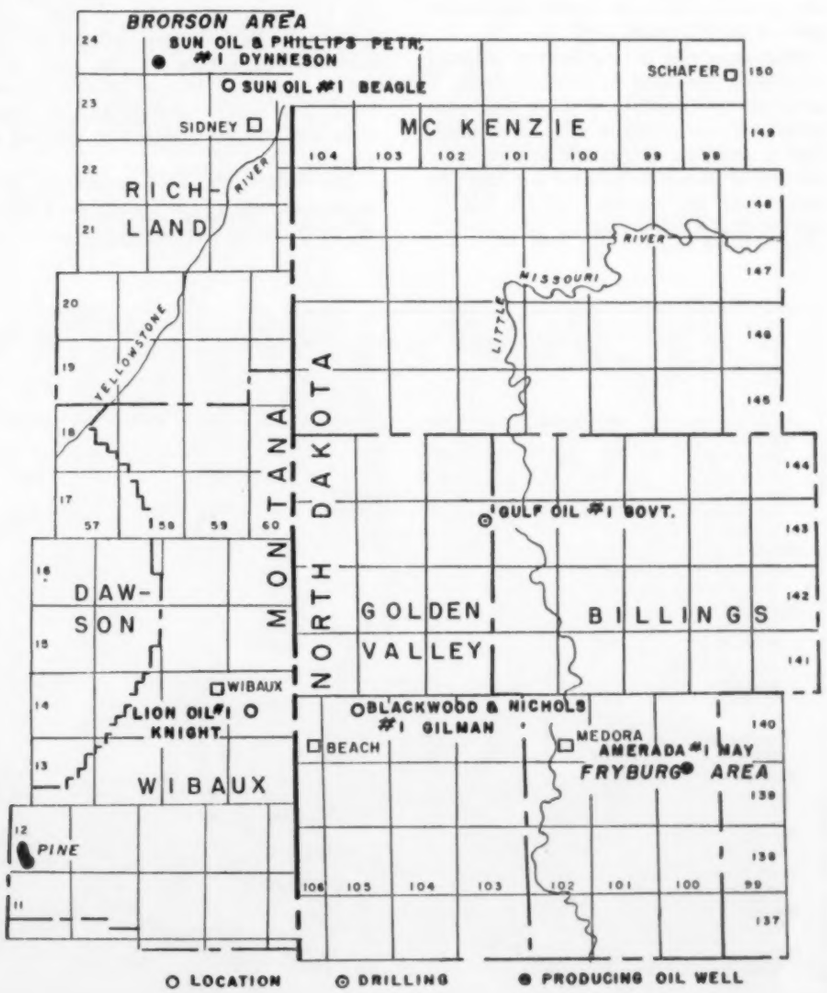
This discovery, in the Brorson area, set a new drilling depth record for Montana at 12,671 feet. Production in the interval mentioned above is also a new producing depth record for the state. In addition to production in Ordovician, the well had shows in Mississippian with most of the section rather hard and tight.

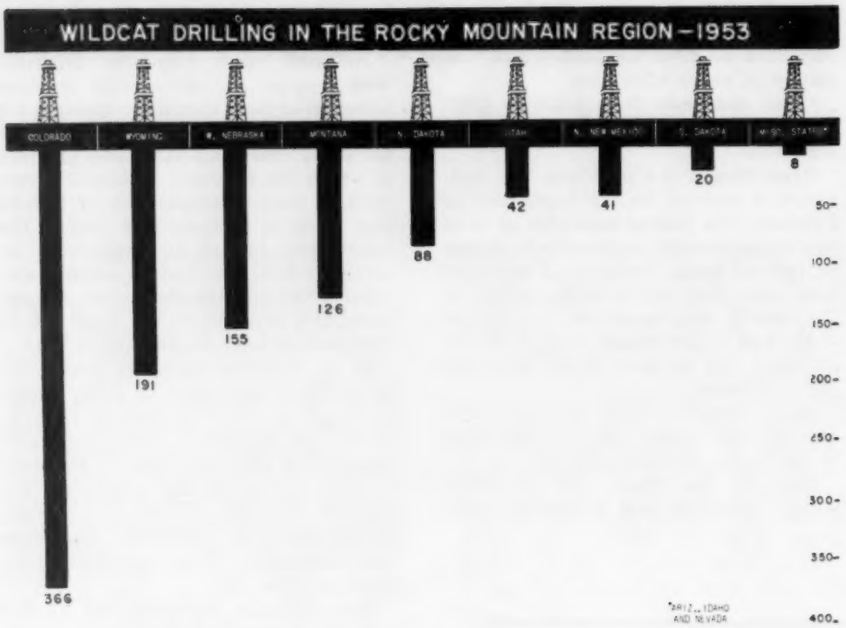
A confirmation well was drilling on this block at the end of January and another wildcat by Sun Oil with Canadian interests was in progress about 10 miles to the southeast. It had shows in Madison and the operator was preparing to run casing for full evaluation of this formation. Failing production in this Mississippian section, the well will be taken to its original objective, Cambrian, at about 13,000 feet.

The discovery at Brorson was followed by another on a seismic prospect at Fryburg, in Billings County, North Dakota. This discovery, Amerada Petroleum's 1 May, C NW NE 9-139n-100w, produced from Madison above 8,500 feet, but was drilled to a total depth of 13,325 feet. Initial production was 217 barrels of oil per day through 18/64 inch choke. Further drilling during the year resulted in completion of several producers in the area and in recovery of oil from Heath sandstone (Upper Mississippian) which added the possibility of a new horizon. No completions have yet been attempted in Heath.

A line through Fryburg to Brorson establishes a trend parallel to the productive Cedar Creek anticline through eastern Montana and terminates in the Pop-

BRORSON—FRYBURG AREA
MONTANA & NORTH DAKOTA





lar area, Montana's most prolific Williston Basin field. This line also approximates the deeper axis of the central Williston Basin. This area presented the most interesting exploratory questions in the basin at the close of 1953.

Gulf Oil reported shows, probably of commercial value, in a wildcat in eastern Golden Valley County, just east of the Fryburg-Brorson axis. Blackwood & Nichols also reported some shows in a deep test southwest of Gulf's wildcat, also along this trend. About 12 miles further west, in Wibaux County, Montana, Lion Oil was reported to have shows, possibly commercial, at about 10,000 feet in another wildcat. None of these three wells was complete at the end of the year. In the case of the Lion wildcat no official information was available.

These wells mark a trend of exploration through the deep portion of the basin and parallel to Cedar Creek which is apparently to be one of the most active areas in the basin during the coming months. All were located from geophysical information. The Fryburg discovery was North Dakota's first off the general Nesson anticline. All these wells indicate that geophysical problems which have plagued operators in the Williston Basin may be nearing solution.

Other developments in this basin included a discovery at Cabin Creek, Fallon County, Montana, by Shell Oil. Gauge on tests of Silurian and Ordovician in this well was reported as 4,235 barrels per day, on a calculated basis. No consideration was taken of a considerable Madison section which had shows. The discovery is on the Cedar Creek anticline and south of Pine unit. Confirmation drilling was under way at the end of the year.

Drilling continued at East Poplar, and this district strengthened its position as the leading producing area in Montana's part of the Williston.

The state had a total of 126 wildcats completed, resulting in 12 discoveries. A total of 325 development wells was completed. While Montana activity at times during the year appeared less than spectacular, it should be pointed out that the state held its relative position among Rocky Mountain states as to total activity, even though all activity advanced by 45 percent.

One disappointing Montana area was the northeastern corner of the state, where several deep wildcats proved failures.

In North Dakota, a substantial development program in fields of the Nesson anticline, notably Tioga and Beaver Lodge, continued through the year. There was a considerable amount of unsuccessful wildcatting through the east side of the Williston Basin in the state, but without success except for some small producers in Bottineau County.

The shallow eastern prospects of the basin are of great potential importance and drilling done to date may not be regarded as at all conclusive except for certain very limited areas. East side exploration apparently will continue, though not at an immediately accelerated tempo.

There were 11 discoveries in North Dakota during the year as a result of 88 wildcat completions. Two hundred sixty eight development wells were drilled for 172 oil producers.

Interest in the South Dakota portion of the Williston Basin was materially increased by discovery of oil in Harding County by Shell late in 1953. The company's Buffalo area wildcat in the northwestern corner of the state produced about 135 barrels of oil per day from Red River (Ordovician) on early tests and was still testing at the end of January.

The well is the first apparently commercial success in the state. As a result of early tests, prices offered at state

DRILLING STATISTICS FOR THE YEAR 1953

	No.	Oil	Gas	Dry	Footage	% Success	% Dry	All Wells	% Success	% Dry
Wyoming										
Development	735	596	22	117	3,630,173	84.0	16.0	926	70.2	29.8
Wildcat	191	29	3	159	965,574	16.7	83.3			
Colorado										
Development	372	229	50	93	1,919,274	75.0	25.0	738	43.2	56.8
Wildcat	366	28	13	325	1,941,448	11.2	88.8			
Montana										
Development	325	209	23	93	1,167,130	71.4	28.6	451	54.1	45.9
Wildcat	126	12	0	114	766,183	95.0	90.5			
North Dakota										
Development	180	162	0	18	1,498,746	90.0	10.0	268	64.5	35.5
Wildcat	88	10	1	77	455,391	12.5	87.5			
Western Nebraska										
Development	155	102	8	45	843,618	70.9	29.1	310	43.8	56.2
Wildcat	155	21	5	129	790,283	16.0	83.3			
Utah										
Development	28	14	5	9	159,683	67.8	32.2	70	37.1	62.9
Wildcat	42	3	4	35	235,999	16.6	83.4			
Northern New Mexico										
Development	585	8	549	28	2,401,126	95.0	5.0	626	91.3	87.0
Wildcat	41	2	13	26	213,400	36.6	63.4			
Arizona										
Wildcat	2	0	0	2	9,665					
South Dakota										
Wildcat	20	0	0	20	102,585					
Nevada										
Wildcat	3	0	0	3	5,510					
Idaho										
Wildcat	3	0	0	3	15,978					

school landlease sales advanced considerably over previous figures.

The discovery is on a southward extension of the Cedar Creek anticline and as such was not of the extreme interest which would have been the case if it had been completely separated from a previously producing structure.

In Wyoming the usual pattern prevailed in 1953, with important developments in every part of the state. The east side of the Powder River Basin, notably Weston County, was the most significant area during the year.

Early in 1953, discoveries south of previous production in this county were completed in Newcastle sandstone with potentials up to 1,500 barrels per day. By mid-year a major drilling program had developed in a trend extending southwest of the older Clareton field. More than 50 of a maximum Wyoming count of 147 rotaries were busy in Weston County in early fall.

By the end of the year production was extended over a north-south extent of about 20 miles, with width of the producing area as much as seven miles in spots. No boundaries were conclusively established. Early in 1954, production was extended into northern Niobrara County and a rash of discoveries apparently has established a considerable producing area in this county.

The area has always been a center of independent operations and highly diversified lease ownership is one of the factors which has created a high level of activity.

Credit must also be given to the advent of the sandfrac process. When Mush Creek, Clareton and Fiddler Creek fields were under development shortly after World War II, production had ample outlet and wells were shot with nitro, and produced without control, resulting in short lived flush production. The sand-fracturing process has produced wells where older methods would not even have indicated running casing. In addition, available pipe line facilities and markets, balanced against rapid development, have effectively limited production with 50-75 barrels per day the reported take per well.

In any case, the process has come into general use in the region, with spectacular results. Development on the east side of the Powder River Basin is apparently to take several years longer.

Additional discoveries in the Sussex area of Johnson County continued the development of the southwest side of the Powder River. Continental Oil added a sixth and seventh pay in Sundance and Amsden in the area. A shallow Shannon sand discovery was made in the Dugout Creek area, northwest of Sussex, and under a drilling program by both independents and majors a considerable number of producers was completed by the end of 1953.

In the Big Horn Basin several discoveries were made in Phosphoria and Tensleep along the east and southeast side of the basin. Gulf Oil's discovery south of the Manderson unit in Big Horn County was chief among these. Work during the year indicated a considerable addition to sour crude reserves in this area and further justified the construction of a sulfur extraction plant which is to be started this year. In anticipation of this plant's completion, further deep drilling in the area southwest of the Worland has begun. Discoveries were made in this area in 1951 and 1952, but development was delayed.

Older fields of the basin had a rather heavy development in 1953 as market outlet developed. There was also a growing interest in exploration along the west and northwest rim of the basin.

Wyoming's Wind River Basin was in the spotlight at the end of 1953 as a result of a deeper pool success in the Beaver Creek field, Fremont County. Madison was proved productive by Stanolind Oil & Gas, and, in view of the large area of shallower horizons in the field, the discovery was regarded as of much potential importance. Early in 1954 a test to granite in this field was announced.

Discoveries were also made north and southeast of production at Sand Draw. Both these remained to be confirmed and developed at the end of the year.

Wyoming's Green River Basin, in the southwest quadrant of the state, had no major discoveries, but was one of the most interesting areas in the region during the year. Further drilling at Stanolind's 1952 discovery in the Middle Mountain area of Sweetwater County was successful. Development and evaluation of the Big Piney, Sublette County area, resulted in establishment of a calculated reserve of 400 billion cubic feet of gas in shallow sands.

Gas production in Mesaverde sand in this basin, found in 1952, became a key question with the increase in interest in natural gas through the entire region. Proposal of the Pacific Northwest pipe line from San Juan Basin of northern New Mexico to northwestern states made the evaluation of the area desirable. In view of this interest, and the fact that the Green River Basin is regarded as one of the Rockies' most encouraging areas for development of gas, activity is apparently to rise through this large but relatively unexplored province.

Wyoming had 191 wildcats completed, with 32 discoveries. Development drilling accounted for 735 wells, 618 of them successful. Nearly 4,600,000 feet of hole was drilled in the state.

In Colorado the discovery of oil in Lyons sand of Permian age was the overshadowing development of the year which included a number of important developments. Discovery was made in this horizon at the older Keota field in Weld County. Offsets to the discovery proved disappointing as did a minor wave of pre-Cretaceous exploration which followed. The 279-barrel per day potential of the

(Please turn to page 91)

Shell Oil's discovery in Harding County, S. D. The well found production in the Red River member of Ordovician and is apparently the first commercial producer in the state.

Delineation of petroleum areas by radioactive emanation survey

By Robert A. Stothart*

OF ALL THE METHODS devised by the ingenuity of man for probing below the surface of the earth for indications of buried petroleum, the determination of radioactive emanations is the only one that does not require any penetration of the surface or the invasion of an area with a fleet of trucks or, in the case of flooded areas and submerged lands, the detonation of explosives below the surface of the water.

Crude oil and allied hydrocarbons are not in themselves radioactive, to be located or traced by geiger counters as are deposits of some of the rare metals now being extensively sought, but experience over many years has demonstrated that a radioactive anomaly does exist over a zone or zones in which there are hydrocarbon deposits. This anomaly, recognized as accompanying possible oil producing areas, cannot be used quantitatively, but only as a directive toward those areas where the drill will find production if the condition causing the anomaly is such as to be commercially attractive.

While the tracing of this radioactive anomaly across virgin territory has located favorable areas which later have been proven by the wildcatter, and should be used in making the first wildcat location, it is in the province of field extensions that the determination of the variations in the rate of emanations is most useful. When an area discovered through subsurface or other geological exploration is proven by the first successful wildcat, the radioactive survey can be utilized to determine the trend of the producing area, and to outline such subsurface complications as buried faults, grabens, pinchouts, fingering, shorelines and stratigraphic traps.

Automatic recording of the variation in radioactive emanations is an integral and most important part of the survey. In this phase the human element is practically eliminated through the use of an instrument which can be zeroed in on any location, and then left to function with its pickup unit, transmitting to the recorder the variations at each station. By plotting the results obtained at each station, a simple pair of traverses, at right angles to each other or as close thereto as topography and surface barriers will permit, will outline the trend of the area in which the radioactive anomaly is present.

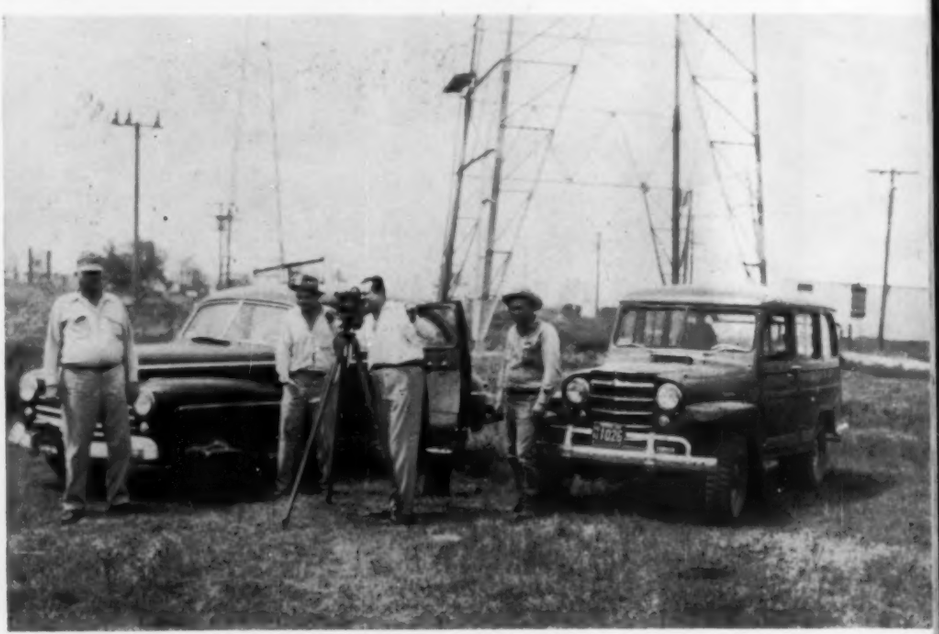
Supplementary traverses, with the stations spaced closely or far apart as dictated by the experience of the survey operator, will amplify the data plotted on the first cross traverses, and will allow the skilled interpreter to indicate with remarkable exactness the most favorable location for drilling not only the first offset to a successful wildcat, but also the trend along which leases should most likely be secured or held to cover the probable trend of the producing zone. This use of the radioactivity survey has been demonstrated repeatedly in the Kansas "shoestring" fields, where the producing sands are found in subterranean river beds, and where the commercial zone is often completely exhausted by a single line of wells following the tortuous windings of the buried stream.

Without the evidence in these surveys, it became necessary to drill lateral offset wells to each producer to determine the course of the shoestring sand—in effect making the drilling cost of each producing well double or treble that of the unit had it been possible to locate the well with the assurance that it was placed within the limits established by the radioactive anomaly. Earlier articles on this type of productivity determination[1] have appeared in the literature, in which the delineation of the attenuated sands is detailed and illustrated with field maps showing the close coordination between successfully producing wells and the range of radioactivity recordings.

Delineation of faults, grabens and other underground unconformities which affect the oil-bearing zone is obtained through radioactivity surveys once the characteristics of the producing area have been determined through a survey around the producing well. The sharpness of such delineation is evident when the contour maps of such phenomena are studied[2] where the location of stations on 100-foot intervals enabled the prediction as dry of a test hole drilled as a direct offset to a producing well which, operating under State proration, has been a profitable undertaking for over 15 years, and the end of whose producing life is estimated to be still some 20 years from the present.

Activity in the Spraberry and similar reef trends of West Texas brought with it the drilling of large numbers of dry holes in attempts to define the exact limits of the producing reefs. Application of

*President, Radioactive Surveys Company, P. O. Box 1917, Houston, Texas.



While the landowner looks on, a base line for a radioactivity survey is laid out with the drilled, producing well in the background as the focal point of emanation readings. The pickup unit rests on the ground just behind the surveyor, and will furnish the readings to tie in with the base point of the grid.

Mounted behind the driver's seat of car or Jeep, the recording unit may readily be swung around so it can be watched from outside the car if conditions of the survey warrant it. When traveling, the pickup unit rests in a sponge rubber-lined socket just beyond the water cooler.

the principles and specialized technique of radioactivity surveys[3] proved that the basic conclusions developed with proficiency in applying this supplemental aid to productivity delineation were also useful in determing the trend of the reefs and in eliminating the drilling of holes which—on grounds of geological data—would be expected to penetrate production.

The radioactivity survey, as with other types of geophysical probing beneath the earth's surface, may be made in two or more steps. The first or preliminary survey may follow roads, trails and other natural or man-made routes of access to the territory to be checked. These traverses, preferably criss-crossing at right angles to form a grid, provide a base on which subsequent surveys can be tied as desired.

For the second and later surveys, when stations are desired at 100-foot or other close intervals, it is necessary only that the terrain be traversible by Jeep, and that the survey lines be carried across the ground in approximately straight lines to afford ready means of comparison of the results obtained.

To take a reading, the position is first plotted on the map by means of a surface survey, and the ground then leveled off to provide a stable site on which to set the pickup unit. It is not necessary to bury the base of this unit, but only to remove loose rocks, weeds and other surface obstacles which might damage the pickup or interfere with its firm positioning on its base. After zeroing in on the site, the readings are recorded until, in the opinion of the skilled operator, an exact picture has been formed on the chart of the activity of the radiations picked up by the unit on the ground. The operation is then repeated for the next station, and so on, until the traverse is completed.

Both the pickup and the recording units are sturdy, and will stand transportation over any type of terrain which the Jeep can cover. Since it is the rate of change of the recordings between stations, and not the amplitude of any given station's radioactivity, the operator may choose any scale on the recorder which is suited to the ground being covered, and these variations are plotted on the map to define the contours of like radioactivity on and around the zone being tested.

As with other types of surveys, the obtaining of a radioactivity survey is dependent on the weather. Magnetic storms, sun-spots, and other disturbances which are known to affect radioactivity of the surface layer of the earth impose periods when no surveys can be run. Determination of when a survey can be resumed after interruption by such disturbance lies with the experienced operator. This resumption can (and should) be checked by re-running one or more traverses over the terrain after a period of time has elapsed since resumption of work, when the scope of the readings may be found to have varied from that of the earlier run, but which may be regarded as confirming initial results or challenging them, depending upon how closely the trends of the two sets of data coincide. Marked discrepancies indicate that the after-effects of the disturbance are still affecting one or both sets of readings, and the survey is re-run after allowing still further time for the subsurface radiations to be recorded without distortion from surface conditions.

Radioactivity surveys are not recommended as the sole method to be used in checking for faults, extensions, trends and subsurface conditions adjacent to a producing well, nor as a method which should be used alone in delineating unproved terrain. But, employed in conjunction with the seismograph, gravity meter or magnetometer, it can be used most advantageously to fill in the gaps in the records obtained by other methods, and will reduce the amount of nonproductive drilling to a minimum, this minimum being predicated on the experience of the operator, the accuracy with which "edge" wells are drilled, and the previous producing history of the area.

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New patent developments

Conversion of gas oils and heavier hydrocarbons

By Heinz Heinemann and Felix Heinemann

UPGRADING OF HEAVIER petroleum fractions to gasoline and naphtha by thermal or catalytic cracking has long constituted the backbone of petroleum refining operations. Development of catalytic cracking has been extremely rapid since the first report in 1938 by E. J. Houdry on the operation of three fixed bed catalytic crackers with a total capacity of 20,000 b/d. Present catalytic cracking capacity in the United States alone is over three million barrels per day. This tremendous expansion is based on a very large volume of scientific and engineering research which has led to many modifications of the original art. While present day catalytic cracking processes are predominantly of two types, the "fluidized" and the "moving bed" operation, research and development has encompassed others as well as numerous investigations of the effects of catalyst composition and preparation, techniques of catalyst regeneration and means of extending the boiling range and type of suitable feed stocks. The patent literature on thermal and catalytic cracking and conversion reactions has reflected the importance of the subject in the many thousands of patents which have issued and which it would take a fair sized book to review. It is an indication of the emphasis which the petroleum industry and its research laboratories still put on improvements and modifications for the conversion of heavier to lighter hydrocarbons that numerous patents on the subject are still issuing in spite of the extensive coverage in existence which, of course, restricts the number of new and patentable ideas. It is only natural that most of the newer patents deal with catalytic rather than thermal methods of conversion. The industry's difficulty in disposing of residual stocks is reflected in the constantly increasing number of patents concerned with residua. Methods of upgrading them include cracking, hydrogenation and extraction. Some phases of this specific problem have been discussd in an earlier review article ("Hydrogen Processes," WORLD PETROLEUM, November 1953) while others are reviewed in the present presentation which discusses a selection of patents on conversion of heavier hydrocarbons (issued during the year preceding February 1, 1954) in an attempt to show trends in this field of research.

Cracking Technology

With the desire to increase the yield of light fuels, attempts are being made to increase the volume and range of heavy oils charged to cracking. As heavier fractions are being considered as cracking feed stocks, methods of feed stock preparation become more important to avoid rapid catalyst deactivation. Several recent patents deal with feed preparation. W. C. Simpson and W. B. Wilson (2,662,845, Shell Development Co.) describe a thermal pretreatment. The heavy oil is subjected to minor thermal conversion at 370-425°C. A heavy gas oil condensate produced is thermally treated above 450°C to obtain light gas oil components. An overhead stream of light gas oil (for catalytic cracking) is separated in a reflux column from heavy residue. The latter is treated at a pressure below 200 mm Hg to recover a distillable heavy gas oil which is recycled to the thermal treatment. Thermal pretreatment to catalytic cracking is also disclosed in another Shell Development Company patent (2,663,675, R. B. Ewell) for a mixture of reduced crude and heavy recycle oil. Extraction is the feed preparation method used for a wax distillate by J. N. Haresnape and E. C. Housan (2,650,189 to Anglo-Iranian Oil Co.). Aromatic hydrocarbons are extracted from the distillate, using phenol as a solvent. The raffinate is then dewaxed with acetone, benzene or toluene and the dewaxed raffinate is catalytically cracked. Another method of removing polycyclic aromatics from catalytic cracking feed stocks is disclosed in Standard Oil Company of Indiana patent 2,643,971 (A. P. Lien and B. L. Evering). The oil is treated with HF at 150-400°F to condense aromatics to HF soluble polycyclics. These are then separated from HF insoluble gas oil which is subjected to cracking over silica-alumina type catalysts.

A large number of patents, only a few of which can be reviewed here, is concerned with the actual cracking operation. A fluidized fixed bed is described by P. W. Cornell (2,664,336-2,664,339 to Gulf Oil Corp.). Powdered refractory catalyst is maintained in turbulent suspension in a reaction chamber; converted products are continuously withdrawn. When the catalyst becomes deactivated, the reaction chamber is depressured and the catalyst removed to a regeneration zone. The regenerated catalyst is cooled and returned to the reactor which is then repressured. A plurality of reactors may be employed and regeneration may be carried out *in situ* by means of hydrogenation.

The use of several conversion zones for lighter and heavier hydrocarbons in a single catalyst cycle is the subject of two patents. In 2,653,903 (M. O. Kilpatrick to Phillips Petroleum Co.) a contiguous mass of particles is gravitated through a solids heating zone, a first cracking zone below the heating zone and a second cracking zone below the first. Catalyst is heated above cracking temperature in the heating zone and normally gaseous hydrocarbons are countercurrently cracked in the first zone. Higher boiling hydrocarbons are introduced in the liquid phase into the second zone countercurrent to catalyst flow. Hot gaseous effluent from the first zone is used to heat this oil and uniformly distribute it on the catalyst surface while quenching gaseous reaction products. In patent 2,662,844, F. W. Leffer (to Universal Oil Products Co.) contacts freshly regenerated catalyst with a charge of light hydrocarbons, then with heavy hydrocarbons and finally with a heated lower boiling recycle stream. A single heating and regeneration, but separate conversion zones are employed.

Utilization of the heat of hydration of clay catalyst is part of the invention of 2,658,859 (J. C. Dart to Houdry Process Corp.). Freshly regenerated catalyst in non-hydrated state is contacted with a stream of hydrocarbon vapors under sufficient pressure to transport it to an accumulating zone while heat is transferred from the catalyst to the surrounding hydrocarbons by endothermic conversion of the hydrocarbons. The catalyst is then hydrated to saturation with steam prior to contact with hydrocarbons in the reaction zone. Conversion of hydrocarbons in a lift is also discussed in another Houdry Process Corporation patent (2,663,677, R. T. Savage and E. H. Ivey). The catalyst is transported by hydrocarbon vapors through an upflow path, is disengaged at the upper end of the lift and then passed downward to a gravitating compact bed with a continuously replenished upper surface. The

(Please turn to page 96)

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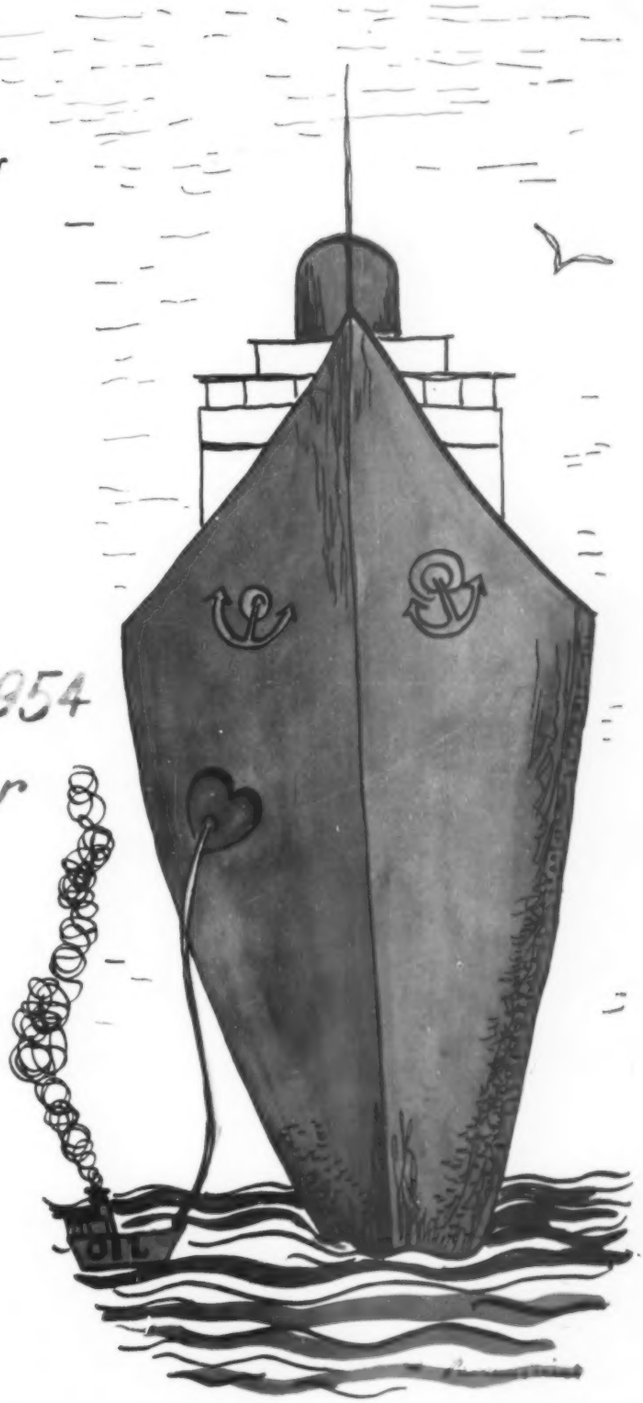

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The Houdriflow unit of Texas City Refining, Inc. at Texas City, Texas is the principal element in an aggressive modernization and expansion program. The new 19,000 BPSD Houdriflow Catalytic Cracker went on stream in September 1953. A charge consisting of vaporized gas oil from a flash tower, plus a liquid-phase mixture of heavy vacuum gas oil and recycle is being cracked into high octane gasoline.

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Turkey enacts new petroleum law

On March 7 the Turkish National Assembly, by a vote of 266 to 17, adopted a new petroleum law opening the door to the investment of private capital in the country's petroleum industry after two decades of government control and operation. Passage of the law was preceded by a study of comparable legislation in Canada, Venezuela and other oil producing countries by Max W. Ball and Elmer E. Batzell, petroleum consultants of Washington. Mr. Ball has spent much time in Turkey during the past two years consulting with Turkish officials and framing provisions of the law.

Oil men familiar with the provisions of the new law express the opinion that it will be beneficial to Turkey by stimulating exploration and development of petroleum resources while providing fair terms for concessionaires. Even before final enactment of the law, some international companies have been making preliminary studies under authorization of the government and it is expected that there will be numerous applications for exploratory rights. Among the companies showing interest are Socony-Vacuum Oil Co., California Texas Oil Co., Conorado Petroleum Corp., Standard Oil Co. (N.J.), Royal Dutch/Shell, Cities Service Co., Gulf Oil Corp. and Sinclair Oil Co.

Among geological experts the general opinion seems to be that no large oil deposits are likely to be found in Turkey, but the extent of exploration that seems in prospect under the new law should provide a definite answer within the next few years. The hope of Turkish authorities is that production may be developed sufficient to meet domestic requirements.

The law is voluminous, filling a document of 64 pages beginning with the declaration that petroleum resources are "under the rule and possession of the state." It also says: "The objective of this law is the prompt, uninterrupted, and efficient development and use of the petroleum resources of the Republic of Turkey through private initiative and investment."

The standards for judging whether an applicant company shall be given petroleum rights are specified as, first, whether it aids the national interest, and second, its record of "compliance" with the laws of the government, its "experience," "financial ability," and "priority of application."

A Petroleum Administration, staffed by technicians and lawyers, is created, to issue licenses for exploration and leases for production, as well as certificates for construction of pipe lines and other facilities and, in general, to administer the law.

Appeals from Petroleum Administration decisions may be taken to the Minister of Industrial Development or the Council of State.

As a first step, the government is prepared to issue permits or licenses for exploration for oil and gas. These would run for six years maximum, but could be extended for five years more, at the request of the company, in the event of a discovery and to block in the oil and gas area. The limit specified is eight licenses to a company in any district and no license may cover more than 50,000 hectares (1,235,000 acres) overall. The rental on an exploration license is one half a livre (18 cents U.S.) per hectare in the first and second year, running up to three livres after the tenth year.

In the event of a discovery, the holder of an exploration license has first opportunity under the law to obtain a lease for production and a lease "shall be granted," if the licensee asks, covering up to half the exploratory area. The other half of the exploratory area, and any other exploration area later released, may be put up on a competitive bid basis or withdrawn from leasing at the option of the Council of Ministers.

The term of the lease is 40 years and it may be renewed by the Petroleum Administrator for 20 years more "on reasonable terms" if the company has conformed to the laws of the country. The original draft of the bill had called for 50 and 25 years respectively. A lease requires rental payments of at least three livres per hectare in the first year and eight livres in the fifth year and thereafter. The limit on size of oil and gas leases is 25,000 hectares to a lease. A top limit of 150,000 hectares to be held by a single organization in any petroleum district is set out. The Petroleum Administrator may establish "several" districts, but they may not be less than three million hectares each. The number of districts is not further specified, but 12 have been suggested.

Upon the finding of oil and gas in commercial quantity, a royalty is due the government of one-eighth of all production, payable in cash or product as determined. This applies both to licensees and leasees.

Holders of government-approved permits are required to exercise "due diligence" in exploration for or production of oil and gas. The government is permitted to set minimum production levels, when petroleum or gas is found, but these are not to exceed the maximum efficient rate of production. Other provisions are designed to prevent waste. Along this line, oil and gas companies may join in pooling or unit operation of fields to prevent waste, and for economy of development, but only subject to approval of the government. Royalty payments due the government under such conditions may be pooled and paid in a single check for all the participating companies.

A company may lay gathering lines at will, but the construction and operation of a transmission line for oil or gas requires a certificate from the Petroleum Administrator. If oil and gas are to be carried for others, a pipe line tariff must be filed with the administrator and approved. In his decision the administrator is to allow "a reasonable profit" to the pipe line. The law also provides for abandonment of licenses and leases and calls for prompt decisions, usually within 90 days, on the part of the government.

The taxation section of the law, which occupies nine pages in the transcript, provides that all rentals and royalty payments shall be treated as a cost. The law further provides for a depletion allowance of 27.5 percent, modeled after the provision in force in the United States. The oil company is required to use depletion based on the higher of a cost basis or the percentage basis. The half and half split on profits is spelled out in a section requiring of the producer "from and after the recovery by him of the capital in his operation and the profits therefrom charged to a capital account thereof, a surtax on his net income or profits equal to 50 percent of his net income, less his normal tax, direct taxes, rentals and royalties paid or payable to the state by him for the year."

The next section says this:

"The holder's income and net profits shall be liable to no corporation or income taxes except those specified in the foregoing subarticles."

Under other provisions, an oil company may bring in steel and other materials for its operations free of duty, and may export petroleum and products free of export levies. Any capital brought in by an oil company, whether in cash or machinery, may be exported again, as well as certain dividends, and the Finance Minister "shall forthwith issue the requisite permit." The company also may hire "such alien executive, professional and skilled personnel as may be necessary to the effective conduct of its operations."

At present, the government is producing several hundred barrels daily of crude petroleum, and this operation is turned over to a new government unit, the Turkish National Petroleum Co., Inc. This organization will carry on the operation of the small Ramandag and Garzan fields and the unfinished refinery at Batman in the southeast. The new company also is authorized to seek exploration concessions on a footing of equality with private interests.

A start on preparation of the law was made more than a year ago. During 1953, Mr. Ball and Mr. Batzell, the one a consultant and the other an attorney, were asked to draft the code on behalf of the Turkish government. Mr. Ball has been director of the Oil and Gas Division of the Department of the Interior; Mr. Batzell is former general counsel of the Petroleum Administration for Defense, and an oil and gas attorney in private practice. Both men flew to Ankara late last year as the law started through the legislative route, first to approval by a special committee and finally by the assembly. The visit of Celal Bayar, President of Turkey, to Washington last January, furnished an opportunity for top level talks about the law.

U. S. and Canadian oil reserves rise

PROVED reserves of liquid petroleum in the United States increased 1.4 billion barrels in 1953 to 34.3 billion barrels, according to estimates prepared by committees of the American Petroleum Institute and the American Gas Association. Reserves of natural gas increased 11.7 trillion cubic feet to 211.4 trillion cubic feet.

In Canada, a committee of the Canadian Petroleum Association reported an increase in liquid hydrocarbons of 298.7 million barrels to two billion barrels.

Increases in liquid hydrocarbon reserves in the United States were greater in 1953 than in the previous year while in Canada the increase in reserves was not so great as in 1952. In the United States the 1.2 billion barrel increase in liquid reserves in 1953 compares with 764 million barrels in 1952. In Canada the 298.7 billion barrels increase in 1953 compares with an increase of 356.9 million barrels the previous year. Natural gas reserves in the United States increased nearly twice as fast in 1953 as in 1952, the increase being 11.7 trillion cubic feet last year and 5.9 trillion cubic feet the previous year.

The increase in reserves of natural gas liquids was far greater proportionately than the increase in crude oil. Crude reserves rose 984 million barrels in 1953 while natual gas liquids reserves increased 441 million barrels. The increase in natural gas liquids was 8.8 percent while the crude increase was only 3.5 percent.

Rocky Mountain and Williston Basin areas were large contributors in 1953 to the increase in crude reserves. New oil found in this region was nearly as large as that found in the mid-continent group of states. Wyoming reserves showed the largest gain of any state with an increase of 214.4 million barrels. Montana reserves gained 52.8, North Dakota 52.1 and Colorado 13.6 million barrels.

Texas reserves increased only 0.6 percent or 82.4 million barrels, and at the end of 1953 were rated lower than at the end of 1951. In 1952 the committee had written down Texas reserves at 398.8 million barrels.

Louisiana and Oklahoma were the leading areas in volume of new reserves discovered in 1953. Louisiana reserves increased 202.1 million barrels and Oklahoma 194.6 million barrels.

On the west coast, California reserves rose 65.2 compared with 93.3 million barrels the previous year.

The additions to proved reserves were accomplished in the face of record-breaking withdrawals of oil and gas in 1953. Production of liquid petroleum was estimated at 2.6 billion barrels, and that of natural gas at 9.2 trillion cubic feet.

New supplies of liquid petroleum developed in 1953 aggregated slightly more than four billion barrels, according to the API. This means that for each barrel of oil withdrawn from the ground last year, the industry found enough to add slightly more than half a barrel to reserves.

With respect to natural gas, new supplies developed during the year amounted to almost 21 trillion cubic feet. Here too, the development parallel is similar. For each cubic foot of gas withdrawn from the ground last year, 1.27 cubic feet were added to reserves.

In western Canada, Alberta crude reserves increased 98.1 million barrels, Saskatchewan 57.9, and Manitoba 8.8 million barrels. Major discoveries late in the year at Pembina and Smiley were not far enough advanced in development to greatly affect the committee's figures.

The joint API-AGA report covers new discoveries, revisions of previous estimates and extensions of known pools. The reserves represent known supplies, the location and extent of which have been established by continuous drilling programs. They do not include any estimate of the oil or gas in the United States which later may be found to underlie the vast acreage known to be favorable to the accumulation of oil and gas, but which still remain untested.

The following tabulation shows changes in total reserves in the United States and Canada by product:

UNITED STATES RESERVES

Liquid Hydrocarbons (Thousands of Barrels)

Reserves	Dec. 31, 1952	Dec. 31, 1953	Increase Over 1952
Crude Oil	27,960,554	28,944,828	984,274
Natural Gas Liquids	4,996,651	5,437,922	441,271
Total Hydrocarbons	32,957,205	34,382,750	1,425,545
Natural Gas (Millions of Cubic Feet)			
Natural Gas	199,716,225	211,447,132	11,730,907

CANADIAN RESERVES

Liquid Hydrocarbons (Thousands of Barrels)

Crude Oil	1,679,509	1,845,422	165,913
Natural Gas Liquids	65,374	198,126	132,752
Total Hydrocarbons	1,744,883	2,043,548	298,665

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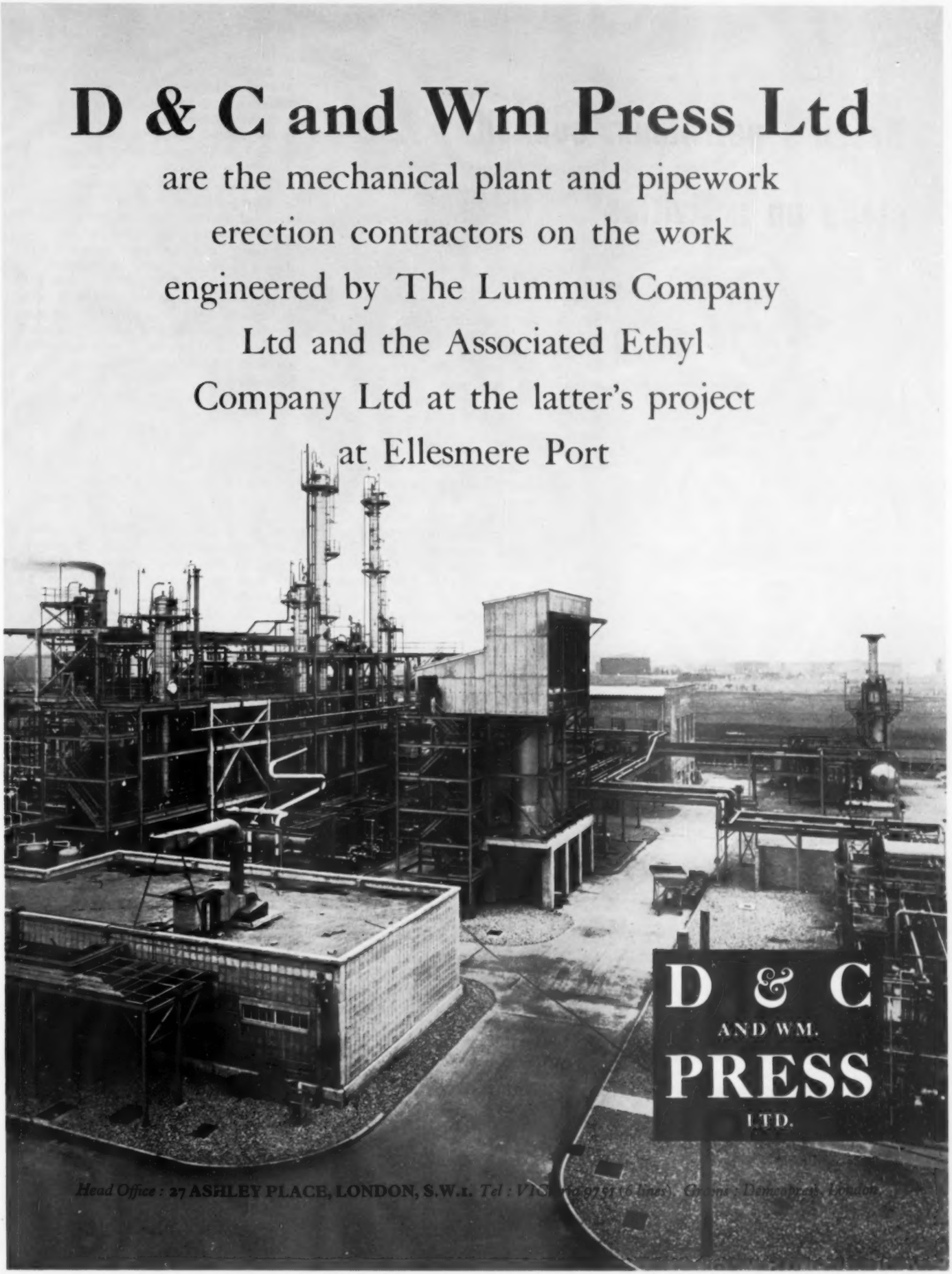

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Brazil's petroleum council steps up activities

By R. G. Walker

DRILLING OPERATIONS were started early in November on pioneer well N.O.1-Az, near Nova Olinda, on the right bank of the Madeira River, 125 kilometers from Manaus, where geophysical investigations had revealed an anticlinal structure with an area of 20 square kilometers. First results, reported by the engineer in charge, Decio Oddone, indicate that oil may now be found for the first time in Brazil outside the Bahia zone. The stratigraphic column showed a diabasic layer between 780 and 832 meters and one of rock salt, 120 meters thick, between 832 and 958 meters. Between 966 and 969 meters the column revealed 2.1 ms. of rock salt, 0.3 m. of anhydrite and 0.30 m. of lime, impregnated with petroleum. Other wells are being put down in the neighborhood to ascertain the extent of the occurrence.

Nova Lima is the fourth wildcat drilled during the six years the Council has been operating in the Amazon region. The other three were in the state of Para, one at Limoeiro, on the Tapajos River, and two in the Amazon delta. All three were dry.

Advices from Belem announce the start of drilling in March at Mexiana Island, off the north coast of Marajo, with a rig recently received from the United States.

The wildcat at Jacarezinho, in Parana, where two anticlinals were marked out in 1949, has now reached a depth of 1,000 meters. Appearances thus far are not considered encouraging. The Angatuba wildcat, across the border in Sao Paulo, was abandoned as dry earlier in the year. The Jacarezinho area, in Parana, and the Porangaba-Guarei area, in Sao Paulo, were considered until recently to be two of the most promising oil and natural gas zones outside Bahia.

Bahia reports the discovery of a new oil area in the Agua Grande field, municipality of Catu, at a depth of 200 meters. Five other wells were drilled in this area earlier in 1953, one of which yields oil at 1,233 meters and justifies the inclusion of the Agua Grande field among Bahia's best producing zones. Of 45 wells drilled in the first six months of 1953, 37 yielded oil, as compared with 16 oil-bearing drillings, in 24 completed wells, during the corresponding period of 1952. The total depth drilled was 28,685 meters (93,227 feet) against 16,608 in 1952.

Production of crude reached 473,628 barrels at June 30, 1953 and the Mataripe refinery had supplied the Bahia market with 185,444 barrels of gasoline, 877 of kerosine, 24,949 of diesel oil and 160,769 of fuel oil, as well as with small quantities of solvents and liquefied gas. The second refining unit has now been completed, raising capacity to 5,000 barrels daily, and tenders will be called for early in the current year to install a unit to produce lubricating oils.

An excess of paraffin in the oil threatened supplies from the Dom Joao field to the Mataripe refinery during its second phase of operation. The needs of the first phase were met exclusively from the Candeias and Itaparica fields. The trouble at Dom Joao was overcome by the fluid injection process.

The Petroleum Council recently issued instructions for the distribution and supply of liquefied petroleum gas. Companies wishing to supply gas for domestic or industrial purposes must obtain authorization from the Council, which will approve specifications and fix sale and re-sale prices. Distributors may not monopolize the supply of apparatus or installations, nor require the use of their own materials.

The necessary installations have been inaugurated at the Aratu field to supply natural gas to the East Brazilian Federal Railway for use in a thermal power station at Cotegipe which will supply current for the electrification of the line. The Aratu field is the first to produce gas for commercial purposes in Brazil. It has a productive area of 490 acres and calculated reserves of 869 million cubic meters of gas, at a pressure of 72 atmospheres and with calorific power of 8,900 calories per cubic meter. Of 16 wells drilled in this area, 10 yield gas and two oil. Three separating units have been installed, each with a capacity of 425,000 cubic meters. The Council undertakes to supply 35,000 cubic meters of gas daily under its existing contracts. Another 54,000 are consumed in the Mataripe refinery and the Candeias field for repressuring.

The natural gas of Aratu is now beginning to be exploited by Liquigas do Brasil, but two other enterprises, Companhia Ultragaz do Brasil, founded shortly before the last war, and Companhia Nacional de Gas Esso, a later arrival, are distributing butane and propane gas in drums and cylinders, respectively. Between 1951 and 1952 the number of consumers in the 16 cities served by these two companies increased 24.5 percent, to 285,509. The field for exploitation of bottled gas in Brazil is immense, as only five towns are served by piped gas, and it is becoming increasingly difficult for urban dwellers to obtain wood fuel, hitherto almost exclusively used for domestic purposes.

A sum equivalent to U.S. $30,455,700 has been advanced to the Petroleum Council for its immediate necessities. The amount comes out of the 25 percent proportion of the sole tax on lubricants and liquid fuels allotted under Article 8 of the Petrobras law for the development of Brazil's oil industry. The first deposit, paid into a special account at the Bank of Brazil, amounted to U.S. $40,141,000. A credit of U.S. $12,724,000 has also been opened in favor of the Council for the industrialization of bituminous shales in the Pariba valley, investigation of the Marau schists in Bahia, and for amplifying the Mataripe refinery.

President Vargas has nominated the Attorney General of the Republic to represent the Union in the acts constituting Petrobras. Throughout December the evaluating committees were busy examining the Council's properties, including the Bahia oil fields, the Mataripe refinery and the government plant at Cubatao, all of which will be included as part of the Union's contribution to the capital of Petrobras.

The President of the House finance committee, in his report to the Chamber of Deputies at the close of the 1953 legislative session, estimated that only U.S. $957 million would be available in all currencies for commercial imports in 1954. He suggested that it might be necessary to ration gasoline in order to maintain the trade balance.

Imports of fuel and diesel oils accounted for 5.5 percent and gasoline for 8.6 percent of the value of Brazil's total imports in 1953, as compared with 3.96 and 6.06 percent respectively in 1952. Comparing the first seven months of the past two years, imports of gasoline increased by 10,986 tons in 1953 to 1,323,601; diesel oil by 61,869 to 521,084 tons; fuel oil, by 53,521 to 1,267,812; kerosine, by 34,527 to 209,289; and other liquid fuels, by

(Please turn to page 100)

Chicks from the pipeline?

IN THE MIDDLE EAST a new pipeline is laid. In a western farmyard a healthy young chick emerges from its shell. The connection? Oil, which still heats many an incubator; and Anglo-Iranian, which produces and ships something like 600,000 barrels of oil a day.

From twelve Anglo-Iranian refineries in seven countries pour the life-giving, life-easing products of oil. They are shipped in one of the largest privately-owned tanker fleets to speed development and smooth the path of progress in many parts of the world. Anglo-Iranian ranks high among the world's leading oil companies.

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Reinterpretation of Logging

(Continued from page 63)

contains another until you shift your focus and can see them both.

For years the industry concentrated on seeing in an electric log only the information which would give them correlation and depth. Then it was realized that the information could also be used to determine whether a formation contained oil and gas or salt water. In lowering the electrical instrument down the hole, it, of course, records the natural electric properties of all formations drilled through and their varying resistivities to electricity. The resistivity of oil and gas being high, the log generally records a high kick. Salt water being a conductor of electricity, resistivity is generally low.

This seemed very black and white in the beginning and was a great success, for electric logging achieved its acceptance in the Gulf Coast area where there are simple rocks and even amateur efforts at reading electric logs had a high degree of success. But it wasn't as simple as they thought even in this so-called "easy" area. As the use of electric logging spread to hard rock country, the picture changed even more, whether the interpreters of electric logs realized it or not.

The older, harder rocks are more difficult to interpret. Whether or not you can make an oil well depends upon the outcome of the battle between the relative percentages of water and hydrocarbons in the pore space of the rocks, plus the physical characteristics of the rocks, plus the physical characteristics of the hydrocarbons and water.

For example, a given sandstone in the Rocky Mountains containing heavy oil can only contain 25 percent water without producing water. On the other hand, the same rock with light oil could carry 40 to 45 percent water without producing water. There are many cases of "dirty" sands where the rock can carry 60 percent water without producing water.

It has been a common error in ordinary electric log analyzing to be unable to distinguish these differences and to interpret as a water formation one which could produce oil. Yet the electric logs have faithfully and accurately recorded the necessary information. From them it is possible to determine the type of rocks, depth, thickness and thinness of beds, porosity, permeability and the percentage of connate water or oil or gas in the pore space. But the human interpreters did not know how to recognize all this data.

Today one can even take an old hand recorder log and get saturation and porosity information, something on permeability and the knowledge necessary to decide whether or not to set pipe. Five years ago nobody would have known how to do this.

The data which the electric log records is mathematical and the human element in the solution of complex mathematical formulae and recognizing the distinctions in mathematical data is like a recent cartoon in the *New Yorker*. A group of scientists are dejectedly studying a huge blackboard filled with a fantastically complicated mathematical formula. One of them has just taken his pipe out of his mouth to exclaim, "Say, I think I see where we went off. Isn't eight times seven fifty-six?"

Engineers, with greater mathematical training, generally make better quantitative electric log interpreters than do geologists. However, this new art of interpretation is only partly due to the correct mathematical approaches to the information on a specific electric log. This new tool is the quantitative analysis of electric logs and must be used in conjunction with all other exploration information.

"Sometimes on an exploration test you not only analyze the log in question, but every log made within a radius of five miles," states Dr. Hamilton, who obtained his doctor's degree in geology. "This information is then viewed in the light of all geological information available plus reservoir data. And the final interpretation is then made with the indispensable aid of that most intangible and vital of all tools—experience."

Just how tricky all this can be for the layman is illustrated by what happened to a client of Dr. Hamilton's. He had interpreted an electric log of a plugged hole which resulted in his opening up a new pool. The client later reentered another plugged well in the area because to him the electric log looked exactly like the one which Dr. Hamilton had interpreted as a producer. He set pipe. However, he didn't perforate but waited to consult Dr. Hamilton who was away teaching a logging school. When Dr. Hamilton finally saw the log he immediately said, "You'll get 100 percent salt water on this one." The client couldn't believe the two logs could look so much alike and have two opposite interpretations, but since he had already set pipe he decided to test it anyway. When nothing but salt water was produced, he gave up being his own electric log analyst.

In addition to "know-how," the fact that proper quantitative electric log analysis takes a little time is equally responsible for so much oil being passed up. Just as a penny held close enough to the eye may obscure even the sun, so the consciousness of the cost of rig time while an electric log is being analyzed can result in passing up a new oil field. It is a curious paradox that after spending perhaps half a million dollars to drill a well, everybody is suddenly in a tremendous rush to plug it as fast as possible. Equally paradoxical is the fact that it is standard practice to run an electric log and this is not cheap. The cost of the log may equal five to ten percent of the well cost. That electric logging is big business as shown by the $50 million spent on it annually in the United States alone. Yet, in the majority of wells drilled, the operator is content to take a quick judgment, perhaps by inexperienced personnel, on what the electric log shows.

The more oil discovered by reinterpretation of electric logs, the more quickly today's operators are going to realize that the most important expenditure of money in an exploration test is at the bottom of the hole for thorough and accurate electric log analysis of all formations penetrated.

Also, the proper use of electric log analyzing will save operators many thousands of dollars, Dr. Hamilton points out. The logs he has examined indicate that many oil shows should never have been tested. "Furthermore, logs in an area may indicate that no more wells are justified," he says. "Hundreds of wells are being drilled today which are not justified in the light of available electric log information."

In one respect this new technique can almost be considered a direct oil finding method; it certainly can find directly the oil that has been missed by current exploration methods. Dr. Hamilton predicts that hundreds of plugged holes will be cleaned out just to obtain electric logs. With proper quantitative analysis of adequate electric logs, he believes that the risk element of reentering old holes should be completely eliminated and that, in any event, the odds shouldn't be greater than one out of two.

It is interesting to speculate what discovery averages really should be. At present they actually are one out of nine, but if we knew how many dry holes could have been producers, we might be greatly surprised to find out our batting average could be a great deal better.

This new technique opens up breathtaking vistas in the future of oil prospecting. Areas which have supposedly been examined by the drill and condemned are once again on the prospect list. How much more oil may exist than current statistics reveal it is impossible to estimate at the moment. However, in the light of this new development, all attempts to estimate the probable ultimate resources of the United States are subject to as much reexamination as electric logs themselves.

It is no longer valid to consider that the older areas have been thoroughly tested because the density of exploratory drilling is equivalent to one dry hole for each two square miles. Who can say now that those holes were really "dry?" Since the older areas are subject to such reinterpretation, it is impractical to use what they have produced to predict how much oil will be discovered in untested sedimentary areas.

It must be admitted that oil resources are exhaustible, but with this new technique the day when the last drop of oil will be found and produced is definitely further away.

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CO Boiler

(Continued from page 70)

steam a "first." Actually, it is merely a heat exchanger in which the coils are the tubes and the regenerator is the shell. The coils are similar to a superheater on a fired boiler. The superheater material is "Croloy 5" and has an indefinite life under conditions inside the regenerator with no steam flow through the coils. The superheater tubes are bombarded with very fine hot catalyst particles and the heat transfer rate appears to be from five to seven times greater than in a conventional boiler for the same temperature differential.

For normal operation the quantity of heat to be removed from the regenerator is greater than is required to superheat the available steam from the CO boiler to the desired temperature of 750°F. Therefore, a system of desuperheating stations have been provided so that the steam can alternately be superheated and desuperheated. The schematic flow diagram of the respray steam superheater is shown by Fig. VI. With these superheaters, both the regenerator bed temperature and the steam temperature may be controlled over a wide range of steam flows and required heat removals from the regenerator bed.

The respray steam superheaters perform two functions—that of controlling the regenerator bed temperature and that of superheating the steam from the CO boiler. The regenerator bed temperature is controlled at any point below a maximum of 1,100°F and the superheater steam temperature at 750°F. Provisions have been made to do both automatically.

Saturated steam from the CO boiler passes through the superheater coils or through the bypass around the coils. The regenerator bed temperature controller varies the quantity of steam passing through the coils by controlling a motor valve in a bypass steam line around the coils. Thus, the flow through the coils is indirectly controlled rather than directly controlled by a valve in the line to the coils. This is the automatic control of the regenerator bed temperature.

There are desuperheating stations at the inlet and outlet of each section of the superheater. At the outlet of the first, second and third coils (the superheaters at the inlet of the first coil and the outlet of the fourth coil are for different purposes), desuperheating stations have been provided to spray the superheated steam with condensate. This reduces the temperature of the steam and increases the temperature differential between the steam and the catalyst bed. Since the condensate is vaporized to steam, it also increases the quantity of steam flowing to the following coils. Both the reduced steam temperature and the increased quantity of steam make it possible to remove more heat from the

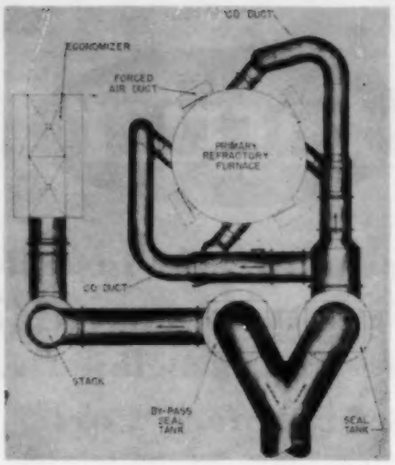


Figure IV: Plot plan of CO boiler.

regenerator. If the regenerator controller will not hold the bed temperature by varying the bypass steam because conditions are out of its range, conditions can be brought into range by spraying condensate into the superheated steam at these desuperheating stations.

After the steam passing through the coils and the bypass are mixed, the blend temperature must be 750°F. This is controlled by a temperature controller which can vary the condensate flow to the desuperheater.

When conditions are such that the temperature controller on No. 4 coil inlet overrides the main steam temperature controller and the steam temperature is not under control, then the quantity of condensate to the other desuperheater must be manually increased to bring the temperature under control.

It was noted previously that the desuperheater on the inlet of No. 1 coil was for a different purpose than the other desuperheaters. During normal operation this will not be in use since the steam from the CO boiler is already saturated steam. However, in the event that it is necessary to operate the fluid unit with the CO boiler shut down, the steam for bed cooling is the plant 550

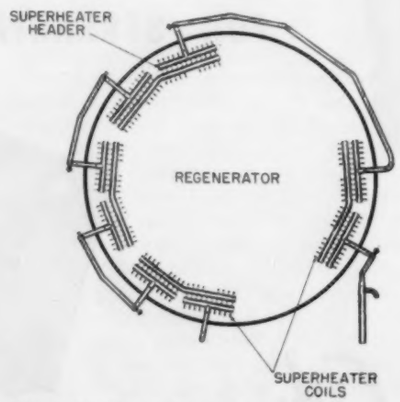


Figure V: General arrangement of steam superheater coils.

psig steam which has already been superheated to 750°F. During this period the first desuperheater would be used to desuperheat this steam to 530°F and the other desuperheaters would be adjusted as for normal operation.

The operation of the respray steam superheater is controlled entirely from the main fluid unit control board. The desuperheating or respray water is condensate. Only in an extreme emergency will boiler feedwater be used for desuperheating because the soluble salts in the boiler feedwater would foul the superheater.

Table III gives the results of actual field tests. It is noted that a transfer rate of approximately 70 was obtained. The design was based on a transfer rate of 67.5. It is noted from the table that the maximum heat absorbed to date was approximately 169 million Btu/hr. The amount of heat required to superheat the steam produced from the CO boiler to 750°F would be approximately 80 million Btu/hr. Therefore, the heat absorbed by the respray steam superheater will vary between approximately 80 million Btu/hr and 170 million Btu/hr. It will depend upon the amount of heat that is required to be extracted from the regenerator bed to hold the regenerator bed temperature at its desired level. The operations to date have been better than expected. The CO boiler produces steam at substantially a constant pressure and rate, and under these conditions even manual control of the regenerator bed temperature is satisfactory.

The installation of the combination CO boiler and respray steam superheater allows for maximum flexibility of operation of a fluid unit to produce more and better products and at the same time provides maximum conservation of fuel. In addition there are several other advantages:

(1) Being independent of outside sources of steam and energy during operation, shutdown or startup.

(2) Complete control of steam production for the fluid unit is under the supervision of the fluid operators.

(3) Steam can be produced at high pressure and temperature which decreases the steam requirements per horsepower for fluid unit prime movers.

(4) Prevents the CO gas from escaping and possible pollution of the atmosphere.

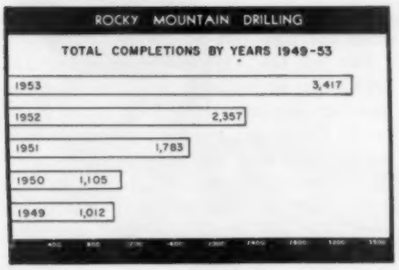
(5) Precludes the possibility of unburned hydrocarbons or malodorous gases (or other gases that may cause air pollution) from escaping to the atmosphere.

(6) Conditions the flue gases for subsequent removal of particulate matter.

(7) Produces excess steam for other refinery uses and reduces the output of the refinery fired boilers.

(8) Eliminates the necessity of an added fired boiler to start up and shut down the fluid unit.

(9) The cost of the CO boiler and its appurtenances is no greater than a fired boiler of equivalent output.



(Continued from page 77)

Lyons discovery at Keota was reported going considerably to water.

However, continued drilling to Lyons resulted in discovery of the Black Hallow field southwest of Keota. The California Company drilled the discovery which was completed for a pump gauge of 304 barrels per day. At the end of the year four producers had been completed in the field and a steady drilling program continued. No failures were completed and no definition of field limits was possible. Exploration to Lyons spread to Kimball County in western Nebraska and to southeastern Wyoming, and south within the Denver-Julesburg Basin. None of these later wildcats were successful. Lyons, where found in these more easterly wildcats, was water-bearing.

At the end of the year a number of deep tests were in progress, with the possibility of substantial Permian production at depths up to 9,000 feet promising to add to the high-level campaign to Cretaceous sand in the basin.

Development of the Little Beaver-Badger Creek areas in Washington and Adams Counties in Colorado established production of more than 11,000 barrels per day and the field became the second largest in the state.

At the end of the year the development program in these fields had subsided, but new interest was created when Continental Oil reported recovery of 43 barrels of oil per hour on test of a wildcat northeast of Little Beaver.

As development at Little Beaver dropped, a new area of interest to the north and northwest in Morgan County was established with the discovery of substantial production in both D and J sands in the Adena area. Early in 1954 a concentrated drilling program was under way in this field and completions ranging to better than 1,000 barrels per day reached a pace of 15 to 20 a week by February.

This field was defined by Colorado's Oil and Gas Conservation Commission as potentially very large in comparison with most Denver-Julesburg Basin fields, but has not yet been defined by drilling.

The Denver-Julesburg Basin was the most active large area in the region. Exploration and development has shown no sign of slackening in the basin and Denver's growth as a city of major interest to the oil industry has resulted largely from its proximity to the area.

Elsewhere in Colorado there was a growing interest in the west side of the state and in the northwestern corner. This again was basically an interest in possible gas production, and grew out of a proposed outlet in the form of the Pacific Northwest pipe line or other possible lines not yet announced officially.

Discovery of Mesaverde gas by Mountain Fuel Supply Co. in the Sugarloaf area of Moffat County was tied in with development of the Green River Basin.

An interesting sidelight to the exploration for gas in the Green River Basin is the fact that the method of drilling with gas has moved northward in the Rockies from its origin in the San Juan Basin. The successful confirmation of the Sugarloaf discovery was drilled by this method.

Southeastern Colorado was the most heavily leased area of the state in 1953. Exploration followed in Baca, Bent and Powers Counties, which include the northwestern flank of the Anadarko Basin of Kansas and Oklahoma. In late 1953 a successful gas well was drilled by British-American and Amerada in Baca County. It was the county's first producer, and was considered an extension of the Greenwood gas field in adjacent Morton County, Kansas. Further drilling is in progress, with at least one additional producer already indicated. Announcement of a test to Madison in Rangley field, where production is from the Weber (Pennsylvanian) was made late in the year. It was not at critical depth at the end of the year, but was regarded as one of the most potentially important wildcats in the region in view of the very large Pennsylvanian production from the field.

Colorado led the Rockies in number of wildcats drilled, with 366. Of these, 41 were discoveries, most of them in the Denver-Julesburg Basin. Development work accounted for completion of 372 wells, of which 279 were successful.

In western Nebraska, drilling was confined largely to Cheyenne and Kimball Counties, with development of the area around Sidney the most consistent program of the year. There was some unsuccessful exploration of the Chadron Arch to the north of previous production, and interest continued into 1954.

At mid-year there was a flurry of interest in reported shows in Ohio Oil slim hole tests in Buffalo County on the western flank of the Salina Basin. This interest declined with no encouraging results produced.

Western Nebraska had 26 discoveries as a result of 155 wildcats. There were also 155 development completions for 110 successes.

In Utah, exploration was somewhat reduced. In the Uinta Basin a small amount of development drilling and discovery of upper Green River production in the County area of Duchesne County north of the Duchesne pool were the principal positive accomplishments of 1953.

The continuing drilling program in the Clear Creek gas field in Carbon and Emery Counties was the most important work of 1953. Three States Natural Gas Co. has completed 13 producers from Ferron sand at about 4,000 feet in this field, some of them for open flow potentials up to 150 million cubic feet per day. At this point reports indicate a total of 21,600 proven acres for this field, with recoveries estimated at 45 million cubic feet per acre, or recoverable reserves of 972 billion cubic feet.

In southeastern Utah, the Paradox Basin became one of the most highly-regarded of prospective areas in the Rockies with recovery of oil from Pennsylvanian formations in the Bluff unit of San Juan County. A flow of 85 barrels of high gravity oil in six hours was reported by Three States Natural Gas, drilling the wildcat on farm-out from Shell Oil, the unit operator.

A test in northeastern Arizona reported shows of oil and gas in Pennsylvanian early in 1954, offering promise of Arizona's addition to producing states.

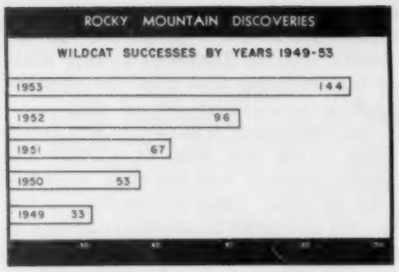
Exploration in Nevada, principally the eastern part of the state, was at an all-time high at the end of 1953, and a promise of continued work through the state is contained in the very high leaseholdings of several major companies.

In northern New Mexico, a heavy development program continued through the year with additional exploration as a result of commitments of developed and potential reserves to the proposed Pacific Northwest Pipe Line.

A total of 41 wildcats in the San Juan Basin produced 15 discoveries for a phenomenally high success ratio. Six hundred twenty six development wells were completed, of which 572 were successful.

Leasing through the Rockies slowed somewhat from previous years. Federal lands in most states were heavily leased in preceding years, and only a few substantial block efforts were apparent in the region during the year. Wyoming had a substantial number of lease applications, many of them on a "take anything open" basis, and many for relatively small tracts. Montana leasing was steady but light with little federal acreage available. Leasing of state lands in this state was stymied with conflict over an act of the 1953 legislature which extended leases from the previous 20 year maximum to life of production. This was opposed, and leasing enjoined.

In North Dakota, Indian land lease sales and Bank of North Dakota sales were held at intervals during the year, with bidding indicating a more substantial interest, but on a selective basis. This



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also was true of Indian land sales which continued in Montana.

Sale of leases on Navajo Indian lands in southeastern Utah, northeastern Arizona and northwestern New Mexico was the outstanding leasing event of 1953 in the Rockies. The sale was the largest ever held by the Indian Service, and a great many major companies were represented by successful bids. There was also a considerable amount of bidding by independents. Bonuses offered ranged up to $129 per acre. Shell Oil was the most active bidder in the area, and paid a good percentage of the more than $7 million offered in bonus for lands through the general area.

That this area, one of the most isolated in the United States, should command such wide and enthusiastic interest is in support of the statement already made that the Paradox and Black Mesa Basins may be expected to generate a considerable exploratory program in the rather near future.

Southeastern Colorado, as already mentioned, was very active, with the relatively small percentage of federal lands much in demand. Most of the acreage through this area is free land, however, and accurate estimates of acreage leased is difficult.

Western and southern areas of the Denver-Julesburg Basin had a substantial leasing program as a result of interest generated by the Lyons discovery and by expansion of previous activity to these limits of the basin.

New market outlets and general transportation facilities developed for the region during 1953 are, more than anything else, indicative of the maturing of the Rockies as an oil-producing province and of the region's assumption of a major place in the domestic industry.

To begin with, the Platte Pipe Line ran at more than 100,000 barrels per day during most of the year. Lines were completed from Merino, Colorado, and Kimball, Nebraska, to furnish crude to the Platte injection station at Gurley, Nebraska.

A line was laid from the Little Beaver field to tie in with the Merino-Gurley line. Talk of another line from Adena to Merino is current.

Gas market in northeastern Colorado was increased with extension of facilities to discoveries by Kansas-Nebraska Natural Gas Co.

Purchase of the Plains Pipe Line out of Weston County by Murchison interests of Texas was announced late in 1953, and plans to expand capacity to relieve the congested Weston County situation were announced. The Pioneer Products line from Sinclair, Wyoming, to Salt Lake City was completed.

The Platte extended its system to the northwest corner of the Big Horn Basin, bought some existing facilities in the Wind River Basin, and was installing additional pump stations to boost capacity to 145,000 barrels per day at the end of the year.

In Montana, construction of the Yellowstone Pipe Line from Billings to Spokane was more than a quarter complete by January. A proposed products line east from Billings to Glendive was yet to start.

Service Pipe Line completed construction of its crude line from northwestern North Dakota to the Mandan refinery now being built by Standard (Indiana). This 30,000-barrel per day plant will find outlet through reversal of flow in an existing line from Mandan to Fargo.

Studies of a possible line from Canada through the Montana Williston Basin and east through North Dakota were in progress by Shell Engineering Co., with report to the 12 sponsoring companies due by spring. This would be a major line to the Twin Cities-Chicago area, and would provide the outlet which the Williston Basin needs for further and more rapid development.

Despite occasional soft markets, production through the entire region was up, as has been mentioned. This was a result of additional facilities for marketing. The promise of continued production at present levels is strong and contains an inherent spur to further development and exploration.

It has become apparent that the Rockies are the target of a shifting center of gravity in the domestic oil industry so far as exploration is concerned. Companies (both large and small) and many individuals have continued to come to the region and further developments of major importance would seem to be indicated.

Both market demand and the economics of the region will continue to be factors strongly felt in future developments. No rapid development of the Williston Basin may be expected until market outlet is forthcoming. In this basin the cost of development is also important. It has not proved cheap, and some estimates place the cost of each barrel of reserves at $1.25 to date. Coupled with high movement cost, this puts the basin's production in a poor competitive position which can be remedied only by lower cost transportation and a gradual standardization of method.

More than 200 million barrels of reserves are estimated for the basin, and this figure has become a strong spur to plans for pipe line outlet.

Out of the exploration, market and production activities in the Rockies, these facts are apparent:

(1) Continued high development drilling is likely, but is tied relatively to overall market conditions.

(2) New areas in plenty to satisfy exploration for some time are available. Among these are many areas of the Williston Basin, the Green River Basin, the central Montana area where activity has had promise but no particular success, the Four Corners area of Utah-Arizona-Northern New Mexico, and southeastern Colorado. This of course takes no consideration of semi-explored areas already benefiting from heavy activity.

(3) New reserves in the region are keeping ahead of accelerated production.

(4) A constantly expanding interest in gas is developing, concurrent with a general industry trend. Very little previous interest in gas has existed outside the San Juan Basin, and, as the desirability of production of this sort becomes more apparent, an increased program will result providing success is had in sufficient quantity.

(5) Promise of sufficient caliber has been demonstrated to make testing of the very extensive leaseholds in the Rockies an economic must in all areas.

(6) Sufficient market outlet has been established to assure every effort to continue the trend wherever reserves are found, and the region will continue to be tied in with markets both to east and west.

Problems peculiar to the region have resulted in new exploration and production techniques which have added to the potential of the Rockies.

A prediction of activity in 1954 would be difficult in view of dependence on national and international developments. A goal of 4,000 wells, when compared with the 3,417 completed in 1953, would seem reasonable. This is of course subject to many factors beyond the direct control of regional operators.

It is sufficient to say that 354 wells were completed in January in Rocky Mountain states, more than in any other January in history, and more than most other single months in history. The trend is set. Only a major dislocation for the industry generally will alter it.

The most significant fact of all is that, of the approximately 3,450 wells increase nationally in 1953 drilling as compared with 1952, 1,060 of the additional wells (or more than 30 percent) were drilled in the Rockies.

Thus, the interest of the industry is clear. Its justification is apparent in the one in seven success ratio for the region.

Rocky Mountain operators will make no rash predictions. Nevertheless, a pessimist is hard to find in the Rockies nowadays.

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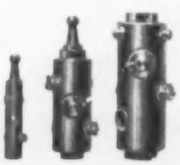

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Intensified efforts are being made to find oil-bearing rock in Papua by the Australasian Petroleum Co. and the Island Exploration Co., both owned by the Anglo-Iranian Oil Co. and American and Australian interests. The companies have drilled seven wells in all for a total footage of 62,645 feet. Photo shows a Catalina flying boat on Lake Kutubu with a local dugout canoe in attendance. Flying boats are used between the oil company headquarters at Port Moresby and the exploration areas.

Two bomb scows carrying men, supplies and equipment along one of the narrow creeks to the headquarters of one of the survey parties deep in the jungle.

Papuan natives collecting seepage oil from the surface of a jungle pool.

Well-head and some of the equipment at the Omati Well No. 1 situated deep in the Papuan jungle.

BRITISH OIL NEWS

By E. Lawson Lomax

The delegation of 20 technical experts representing eight major oil companies which went to Iran early in February to inspect oil installations at Abadan and other southern areas of the country returned to London on the 19th of that month. No report of their findings has been published and the brevity of their trip makes it obvious that no more than a general inspection was attempted. From information divulged, however, it appears that the Persian oil technicians who have been in charge since the personnel of the Anglo-Iranian Oil Co. left the country have endeavored to keep all the installations in good condition and have taken precautions against any possible sabotage, even to the extent of welding up doors and windows of power houses, pump houses and other sections of the various plants so that there should be no means of ingress to them. During their trip some of the experts visited field installations while others made a rapid survey of the refinery at Abadan.

It is generally agreed among oil men and in fact is acknowledged by officials of the Iran government that a large staff of technicians will be required to put the country's oil equipment back into efficient operation. In view of the fact that former members of the Anglo-Iranian staff probably will be barred even if available (which few of them will be) this task will have to be handed over to technical experts from other countries who will be unfamiliar with background conditions.

Other factors such as the complete displacement of Iranian oil from its former markets and the rise in production by other Middle East countries whose interests cannot be ignored seem to make it inevitable that it will be a matter of years before Iranian oil can begin to flow in anything comparable to its former volume while it is highly problematical whether Abadan can ever be restored to its earlier position as the world's leading refinery.

These conditions naturally are much in the minds of the oil company executives who have been conferring in London but with the reports of their technical commission before them, they have resumed their meetings in an effort to form a consortium capable of handling the thorny Iranian problem and to frame a workable plan of operation. Once this has been accomplished a group of top executives will journey to Teheran to discuss the project with the members of Iran's petroleum council.

Equipment for Overseas Refineries

The largest fractionating column ever to be shipped from the United Kingdom left the port of London recently en route to the new Bombay (India) refinery of Burmah-Shell Refineries Ltd. It weighed 50 tons and was 110 feet long with a diameter of 10 feet.

It was manufactured at the works of G. A. Harvey & Co. (London) Ltd. two miles across the Thames from the King George V dock where the column was loaded on the *S.S. Jalaketu*, but to get there it had to travel 75 miles by road.

The first atmospheric tower for the Australian Oil Refinery Ltd., an affiliate of Caltex, at Kurnell, Sydney, is being shipped out to Australia. It weighs 104 tons, is 134 feet nine inches long, and is being shipped in two parts, one 83 feet two inches long and weighing 71.5 tons and the other 51 feet seven inches long and weighing 33.5 tons. The column was fabricated at the Oldbury works of Babcock & Wilcox Ltd. and is being shipped from Liverpool docks.

A coil of nine inch Lion Brand Manila rope 4,000 feet long has been despatched from the works of British Ropes Ltd., to the order of Taylor Woodrow & Co. Ltd. to Accra on the African Gold Coast, where it will be used to tow a submarine oil pipe line from the shore to a tanker discharging standpipe located out at sea.

Oil Production in Britain

During 1953, production from Anglo-Iranian's oilfields centered around Eakring (Nottinghamshire) and Formby (Lancashire) totaled 54,600 tons, bringing the total oil produced from these fields since 1938 to 802,000 tons.

The presence of oil in commercial quantities has been proved in Plungar well No. 2 at a depth of 3,029 feet in carboniferous limestone. Testing is proceeding and the extent of production is not yet known.

A drilling rig is being erected at a site for well No. 3 about one-fifth of a mile from well No. 2. Other wells are being located to test the extent of the producing area.

Petroleum Institute Dinner

The annual dinner of the Institute of Petroleum was held at Grosvenor House on February 24 with H. S. Gibson, president of the Institute, in the chair and H.R.H. the Duke of Gloucester as principal guest. It was the largest dinner function the Institute has ever held, with over 1,100 in attendance. Among the guests were the ambassadors of Iraq, Syria, Lebanon and Jordan, representatives of the Foreign Office, the Services, Cabinet Ministries, the president of the French Association of Petroleum Technicians, and Sir Thomas White, High Commissioner of Australia, who responded to the toast of the guests.

Personnel

P. R. Drew has been elected to the board of directors of Shell Tankers Ltd. and appointed manager of the chartering and freight department. He joined the Royal Dutch/Shell group of oil companies in 1946. Before taking up this present appointment, he was a member of the management of the fuel and light oils department of Shell Petroleum Co. Ltd.

C. H. S. Haygarth, deputy general manager of Shell-Mex and B. P. Ltd., has, with the consent of his company, accepted the appointment of managing director, Pump Maintenance Ltd., an independent organization recently formed with the object of providing a maintenance service for pump and tank equipment.

Electronic Process Control at Aden

Among many innovations in the Aden refinery of Anglo-Iranian Oil Co. Ltd. will be electronic control of the crude oil distillation unit by equipment supplied by Evershed & Vignoles Ltd. and installed by the Bechtel-Wimpey organizations to the instructions of E. B. Badger & Sons Ltd.

Each 6,000-b/sd unit is automatically controlled from a desk designed to fit into a bay window overlooking the plant. The process is illustrated by a colored mimic flow diagram with indicators and controller adjustments mounted at appropriate points.

The electronic controllers are arranged as plug-in units and are nested in cubicles in the side wings of the desks to facilitate rapid servicing. Miniature recorders are provided to record temperature, flow and pressure. In addition to being recorded, the quantities of the various products are totalized by electrical integrators mounted in the side wings.

Signals from the measuring elements of the plant are transmitted over multi-core cables to the control room. The controllers are connected by further cables to electro-pneumatically operated valves on the plant. Some forty controllers are used for each unit, including controllers for flow, pressure, level and temperature. Specific gravity transmitters are also provided to indicate in the control room the specific gravity of various products. Five of the measured valves are connected to alarms to give audible warning of any excess deviation.

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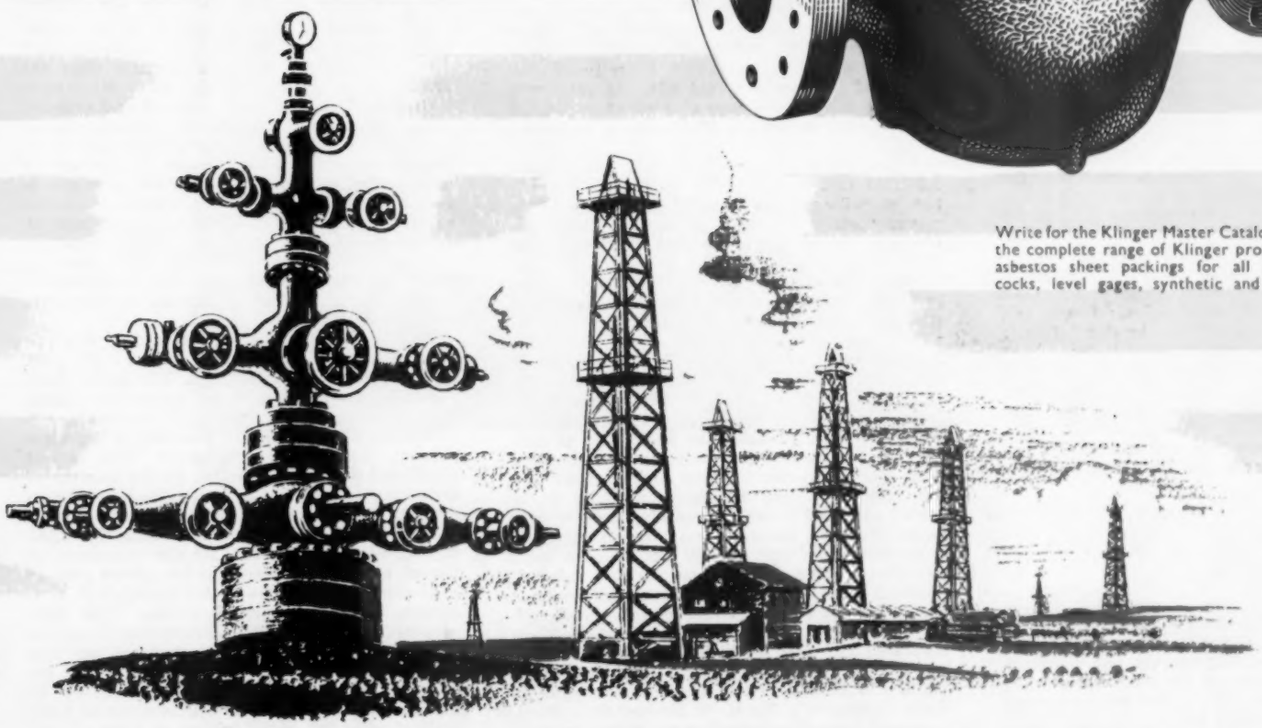

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New Patent Developments

(Continued from page 83)

vapors are heated and partially converted in the lift. The separated vapors are passed with vapors formed by contact of fresh feed with hot regenerated catalyst through the compact descending bed of catalyst at lowered temperature to effect further conversion.

Moving bed cracking operations are the subject of two patents to Socony-Vacuum Oil Co. by E. V. Bergstrom and E. R. Sorf (2,656,306; 2,666,731). Circulating catalyst is gravitated through a conversion and a regenerating zone arranged above each other and is then lifted by a gas stream from the lower of these zones to the upper one. The lift pipe ends in a separating zone above the upper contact zone. A first stream of lift gas is passed into the lower end of the lift pipe without passing it through the catalyst bed. A feeder stream of lift gas is passed through a substantial portion of the bed and then into the lower end of the lift pipe, so as to push catalyst material from the bed to flow into first lift gas stream. The rate of catalyst entering into the lift pipe is regulated by the amount of feeder gas flow. The movement of catalyst in the lift pipe may be affected either by increased pressure of the light gas stream, or by a vacuum applied to the lift pipe.

The recent trend to combination processes involving various interdependent steps of thermal and catalytic conversion is borne out by the appearance of patents on combination processing. Thus, C. T. Harding, M. W. Mayer and R. O. Wright (2,644,785 to Standard Oil Development Co.) distill crude oil to produce a gas oil fraction, a naphtha cut and reduced crude. The naphtha is catalytically reformed, yielding by-product hydrogen. The reduced crude is stripped with this hydrogen and stripped residue fractionated at reduced pressure. Gas oil is catalytically cracked and the residuum is further stripped with cracked vapors. Distillates and reduced crude bottoms are final products.

The search for new crudes and substitutes has focused interest on shale oil. Available in large quantities, its commercial utilization will depend on the development of proper refining and processing methods, which apparently are of increasing importance to the industry. Nitrogen removal from shale oil prior to catalytic cracking is described by R. C. Castner and R. C. Archibald (2,662,843 to Shell Dev. Co.). The shale oil is treated with 2-10 stoichiometric proportions of formic acid for each atomic proportion of nitrogen present in the oil. Extract and raffinate phases are separated and dissolved; formic acid is recovered from the raffinate by distillation in the presence of light nonaromatic hydrocarbons. L. Berg (2,635,987 to Phillips Petroleum Co.) proposes the catalytic cracking of a shale oil gas oil fraction over an alumina base cracking catalyst in the presence of normally gaseous hydrocarbons with no more than 4 C atoms/mole, employing temperatures of 200-700° C at pressures of 300-2500 psig.

Engineering Features in Catalytic Conversion

Improvement in heavy oil conversion can be obtained by mechanical and engineering developments as well as by chemical and processing procedures. Since most engineering improvements require detailed study of the unit design and engineering drawings, only a few of the patents in this field are reviewed here.

Two Standard Oil Dev. Co. patents treat improvements in fluidization. G. L. Matheson (2,656,242) contacts finely divided solids with gases as a dense turbulent fluidized bed having a surface in a lower part of the contact zone, with a more dilute phase above this surface. Fresh gas is introduced into the bottom portion of the bed and treated gas withdrawn from the dilute phase after passage through cyclone separators. Solids are removed as a dense vertical column, which terminates above the bed surface. The column is discharged into a vertical sealing zone, which has a ratio of diameter to depth beneath the end of the column of not more than ⅓ and a zone diameter 1.4-4 times as great as that of the column. An aeration gas is injected upwardly through the bed of solid fines at a gas velocity of 0.05-0.5 ft./sec. C. O. Rhys, Jr. (2,665,976) describes a vertical reactor vessel in the lower portion of which a perforated distributor plate is horizontally arranged. The inlet pipe for introducing vaporous reactants and finely divided solids has a flaring discharge end with an inverted conical distributing member directly above this end in such arrangement that the flow is evenly distributed at substantially the same linear rate as in the inlet pipe. A similar subject is treated by D. J. Bergman in 2,651,565 (to Universal Oil Products Co.). A vertical contacting chamber has a perforated distributing plate extending across the lower portion thereof, the plate ending short of the side walls of the chamber. A supporting skirt extends upwardly from a bottom closure head to the peripheral portion of the perforated plate. The space between the skirt and the walls of the chamber is filled with loose insulating material. A particle outlet is provided intermediate the fluid outlet at the top of the chamber and the plate.

A ferrous metal vessel for the conversion of hydrocarbons with liquid phosphoric acid is described in Standard Oil Dev. Co. patent 2,660,520 (S. R. Bethea). The ferrous metal vessel has a continuous liner of copper directly contacting an internal surface of the vessel and a carbon liner in direct contact with the copper liner and covering it. The carbon liner is porous to allow flow of liquid phosphoric acid catalyst through it. Hydrocarbons to be converted are contacted in vapor phase with the liquid phosphoric acid in the presence of the copper surface.

Conversion of Residua and Cycle Stocks (Coking, Visbreaking, Hydrogenation)

Efforts have been discussed in earlier sections of this review to prepare crackable gas oils by thermal treatment and fractionation of reduced crudes. With the increasing difficulty of disposing of the heaviest fuel oils, the petroleum industry is making a concerted effort to develop processes for converting these residua to lighter fuels.

According to Standard Oil Dev. Co. patent 2,651,601 (W. O. Taff and R. L. Hardy) a virgin residue boiling above 800-900° F is passed to a primary stripping zone under subatmospheric pressure to remove additional gas oil. The stripped residue is subjected to visbreaking and then fractionated. Part of the stripped visbreaker residue is recycled to the visbreaking step and part is removed from the system to prevent excessive accumulation of ash and coke. Another series of patents to the same company (2,655,464-2,655,466 J. W. Brown, H. Z. Martin, E. J. Gohr, C. W. Tyson, J. M. Graham and C. E. Jahnig) proposes a coking process employing a fluid bed and is probably the first group of patents on Standard Oil Co.'s recently announced fluid coking process. Heavy hydrocarbons are first contacted with hot inert particles in a coking zone and then in a cracking zone with a dense, fluidized mass of cracking catalyst of substantially different particle size than the inert particles. After regeneration the hot catalyst is mixed with relatively cool inert particles in a heat exchange zone to reheat the latter and cool the former; the two types of particles are then separated and returned to their respective zones.

A fluid catalyst technique for residuum cracking is also discussed by J. W. Moorman and L. J. Kelly (2,662,050 to the M. W. Kellogg Co.). Feed is passed upwardly through a cracking zone at a velocity limited to permit formation of a dense, turbulent catalyst bed. Hot regenerated catalyst is introduced into the feed stream at regeneration temperature heating it to above 900° F and partially decomposing unvaporizable hydrocarbons. The dry suspension of oil vapors and catalyst thus formed is maintained in the cracking zone for a sufficient period of time to crack a substantial portion of the feed to motor fuel constituents. H. C. Reed and C. H. O. Berg (2,635,947 to Union Oil Co. of California) coke residua in a fluidized bed of particles of higher oxides of iron at 700-1200° F. The coke laden iron oxide particles are separated and treated in fluidized state at 1,000-1,500° F with an oxygen containing gas. Carbon monoxide and coke-free reduced iron are formed. The latter is treated at 800-1,500° F with steam to produce hydrogen and reform the higher oxides of iron.

A thermal method of upgrading residua without coking is described by H. L. Pelzer in 2,662,051 (to Sinclair Refining Co.). The residue is cracked at 850-950° F for 2-15 min., limiting conversion to less than 10 per cent material boiling below 400° F. The products are flashed at atmospheric to 10 psi pressure at 790-850° F. The temperature reduction is effected by introducing 10-25 per cent steam of 212-300° F into the flash zone.

A recent Gulf Res. & Dev. Co. patent (2,662,846 C. W. Montgomery and W. A. Horne) continues that company's series of patents on hydrogenative upgrading. A high boiling hydrocarbon charge containing residues is heated for partial evaporation. The vapors are passed together with hydrogen upward through a fixed bed hydrogenation catalyst at 100-2000 psi. pressure. The liquid portion of the charge is introduced to the catalyst bed while preventing formation of a body level of liquid in contact with the bed. Reaction products are removed from the upper portion of the bed. Liquid drainings from the bed are withdrawn and partially recycled at a point above that at which the vapor portion of the charge initially contacts the bed. Hydrodealkylation of fractions rich in alkylated naphthalenes such as cycle stocks is proposed by 2,653,176 (L. H. Beckberger to Sinclair Refining Co.). The feed fraction is passed together with hydrogen rich gas and steam to a catalyst comprising a major amount of iron oxide with promoting amounts of chromia and an inorganic oxygen containing sodium or potassium compound. Temperatures of 1,200-1,800° F are employed.

Preparation of Conversion Catalysts

Silica-alumina, either synthetic or in natural form as clays has been the most widely accepted and used catalyst and catalyst base since the infancy of catalytic cracking. Many other catalysts, however, have been proposed and explored and the methods of preparation and activation of catalysts as well as of their shaping and forming are manifold and encompass a multitude of publications and patents, the flood of which is still continuing. The art of making an active catalyst has given way to the science of incorporating specific properties to specific materials and most of the recent inventions are based on the recognition of chemical and physical-chemical characteristics needed to promote hydro-carbon conversion.

E. J. Houdry, pioneer in the field of catalytic cracking catalysts, in a recent patent (2,643,980) describes a multilayer catalyst. The active material is built up in a series of deposits by successive impregnations with liquid solutions. A protective film of organic material is deposited between every two active layers. This film is unaffected and not penetrated by the solution of active ingredients, but is removable by oxidation prior to catalyst use. A montmorillonite clay is used by J. N. Haresnape and S. Hesling (2,645,562 to Anglo-Iranian Oil Co.) for the conversion of topped crudes to gaseous hydrocarbons rich in hydrogen. This clay is heated to 500-700° C to remove combined hydroxyl groups. The temperature of activation is in inverse relation to the iron content of the clay, so that e.g. an iron oxide content of less than 1.5 per cent will require 700° C, one of more than 7 per cent 500° C. The removal of contaminating manganese from silica-alumina gel is the subject of 2,634,241 (G. M. Webb to Standard Oil Co. of Indiana). This is accomplished by base exchanging the gel with an aqueous solution of an aluminum salt.

Two Houdry Process Corp. patents deal with the shaping of catalyst gels in bead form. H. A. Shabaker (2,616,857) continuously flows a stream of hydrosol into a body of liquid immiscible therewith and moves the body of liquid from the point of contact of the hydrosol and liquid in the direction of flow of the stream at its velocity. Equal velocity of motion of the liquid and the

(Please turn to page 99)

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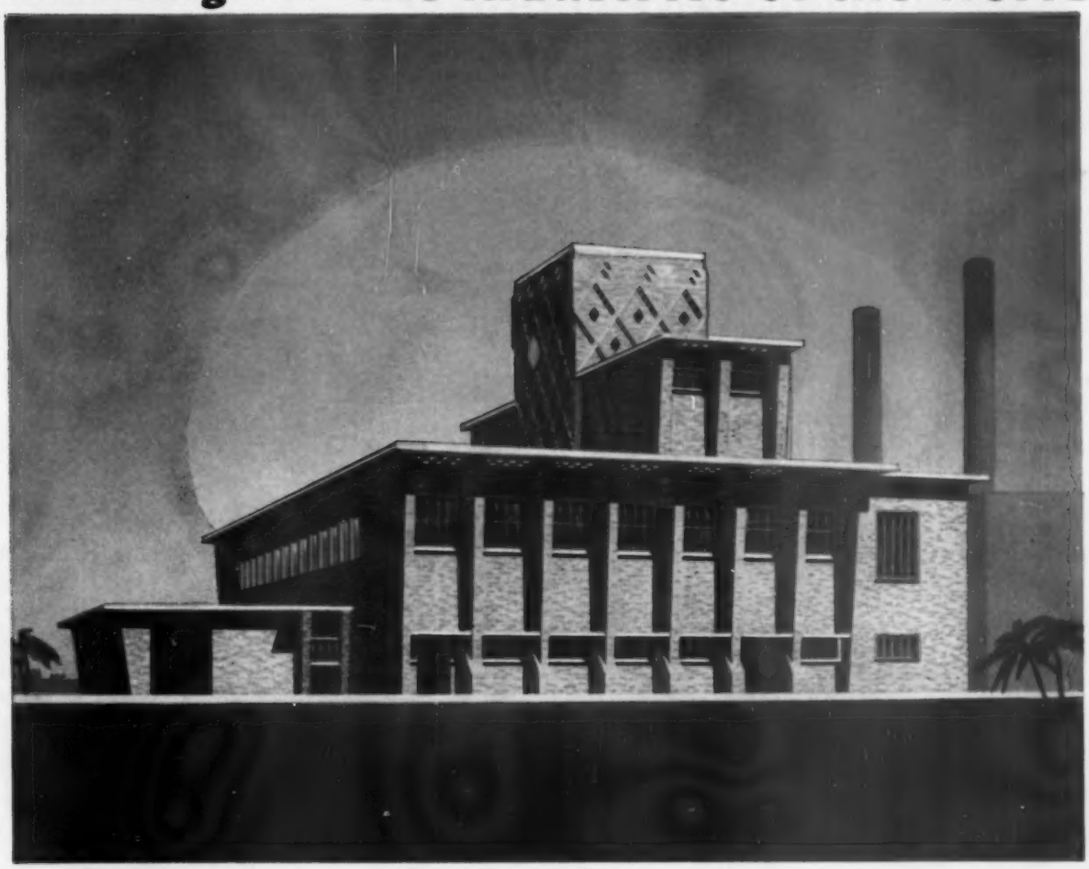

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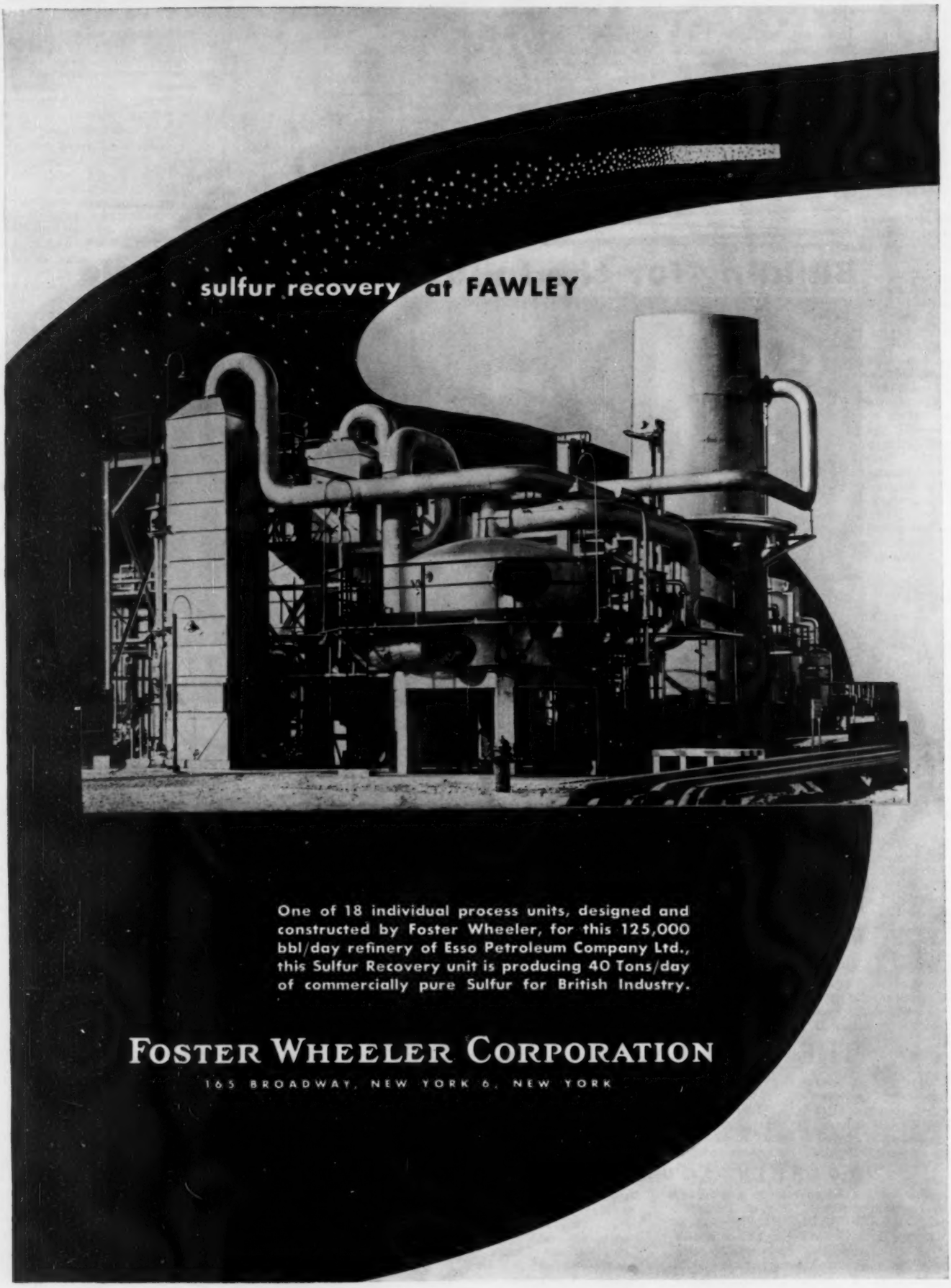

One of 18 individual process units, designed and constructed by Foster Wheeler, for this 125,000 bbl/day refinery of Esso Petroleum Company Ltd., this Sulfur Recovery unit is producing 40 Tons/day of commercially pure Sulfur for British Industry.

FOSTER WHEELER CORPORATION

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New Patent Developments

(Continued from page 96)

spheroidal hydrosol particles formed is maintained until the latter have set to hydrogel. In 2,665,258, E. H. Lebeis admixes inorganic powdered gel with reactants producing gelable hydrosol. The mixture is discharged into a water immiscible liquid to divide the hydrosol into globules by interfacial tension. The hydrogel globules formed are classified as to size and off-size globules are rapidly dried to form an easily comminuted structure which is ground to powder of desired size to provide the powdered gel incorporated into the hydrosol. The selected size globules are partially dried for reduction of volume and further processed. In a patent to Sinclair Refining Co. (2,652,371), J. L. Gring describes a method of forming spheroidal catalyst particles. A body of aqueous sodium silicate solution is discharged as a stream of droplets at an oblique angle. The droplets are separated into at least two fractions, according to the difference of their trajectories. One of the fractions is collected while still liquid and recycled to the body; the other is solidified by contact with a fluid acid medium. A catalyst containing a structural support is disclosed by H. O. Mottern and W. N. Philo in 2,644,800 (to Standard Oil Dev. Co.). A cylindrical metal support has a plurality of annular flanges. Spaced annular pockets formed between flanges are filled with solid catalyst material.

A group of inventions on supported phosphoric acid conversion catalysts has been patented by J. M. Mavity and M. S. Bielawski (2,650,201; 2,656,323 to Universal Oil Products Co.). A calcined composite of a phosphoric acid and a solid support is treated with a hydrolyzable titanium, zirconium or tin compound in an amount sufficient to add 1-10 per cent of a phosphate of the metal to the composite. The product is calcined for greater structural strength. Similarly, at least 50 per cent of a phosphoric acid, an uncalcined siliceous adsorbent and not over 10 per cent of an oxide, hydroxide or salt of a metal of the left column of group IV are mixed and pelleted and calcined at 500-1,000° F.

A number of catalysts described in the recent patent literature are suited for the hydrogenative conversion of higher boiling feed stocks. H. L. Johnson and A. P. Stuart (2,649,419 to Sun Oil Co.) prepare a catalyst containing 10-25 per cent MoS_2, 9-30 per cent iron (calculated as Fe_2O_3), 4-9 per cent silica, 1-4 per cent titania and 40-75 per cent alumina. Catalysts containing molybdena and cobalt, tungsten and cobalt or tungsten and nickel or mixtures thereof are obtained according to W. F. Engel and H. Hoog (2,650,906 to Shell Dev. Co.) by impregnating the elements of the combinations simultaneously in a foraminous carrier by means of an aqueous alkanolamine solution of water-soluble compounds of the elements which are converted to their oxides upon calcination. Another Shell Dev. Co. patent (2,658,875 G. C. A. Schuit and J. J. B. Voorthuysen) describes a nickel containing catalyst. Nickel hydroxide and hydrous silica in a ratio of at least 1:1 are precipitated. The precipitate is treated with water under pressure at above 100° C until one half of the nickel is converted to nickel montmorillonite. The product is then reduced at least 425° C until more than one half but not all of the nickel is reduced to the metal.

Catalyst Regeneration, Separation and Recovery

While the generally used method for regenerating coked catalysts consists of subjecting carbon deposits to combustion, many ways have been found to chemically reactivate catalysts which have lost activity due to structural changes or poisoning and to separate relatively inactive from relatively active particles in a regenerated stream of catalyst.

A Socony-Vacuum Oil Co. patent (2,647,860 C. J. Plank and R. C. Hansford) describes a silica-alumina cracking catalyst containing 0.01-1 per cent of chromia and its use. The chromia assists in the combustion of coke deposits during regeneration.

A method of recovering residual amounts of entrained catalyst from a stream of vaporous reaction products leaving a fluid catalyst conversion zone is disclosed in 2,663,676 (M. M. Cardwell, O. C. Roddey and C. W. Tyson to Standard Oil Dev. Co.). The vapors are partially condensed to separate the residual catalyst as a slurry in heavy products. This is recycled directly to the disperse phase in the upper portion of the conversion zone.

Separation of relatively active and inactive catalyst particles on the basis of their density is discussed in several patents. A Houdry Process Corp. patent deals with granular or pelleted catalyst suitable for moving bed operation. A. W. Hoge (2,643,215) fills the pores of catalyst with a liquid hydrocarbon and mixes the saturated particles with an aqueous liquid of a specific gravity intermediate the maximum and minimum values for particle density. The floating portion is then separated from the portion which sinks in the liquid. The same principle is used for finely divided particles used in fluid processing in Shell Dev. Co. patent 2,631,968 (N. E. Perry). The catalyst is directly dispersed in a liquid of intermediate density and the nonfloating higher density catalyst is discarded as inactive. Another separation of fluid catalyst also based on density is described by A. B. Welty in 2,658,860 (to Standard Oil Dev. Co.). Accelerating gas is injected into a column of finely divided catalyst particles to obtain velocities of 30-100 ft./sec. The catalyst suspension is passed through a confined elongated path having a curved section of 5-30 ft. radius of curvature. The centrifugal force imparted on the catalyst is sufficient to concentrate particles of relatively large weight in an outside stratum of the curved section and to concentrate particles of relatively low weight in an inside stratum. A small amount of gas is injected into the outside stratum transversely to the direction of the catalyst flow to strip out particles of relatively low specific gravity into the inner stratum. The outside stratum rich in contaminated catalyst particles is discarded.

A method for removing fines from granular or pelleted catalysts is disclosed in 2,664,387 (L. F. Strader to Houdry Process Corp.). A cycling contact mass is passed along an inclined chute to cause concentration of the fines along the underside of the stream.

Four patents to Standard Oil Development Co. are concerned with chemical restoration of deactivated catalysts. According to 2,618,613 (C. N. Kimberlin, Jr. and J. P. Bilisoly) spent catalyst is treated with an aqueous 1-2 per cent ammonium fluoride solution at 125° F. The treated catalyst is dried and finally steamed for 24 hours at 1050° F and 60 psi. An alkaline earth metal fluoride is employed in the treatment in accordance with 2,638,453 (C. E. Starr, D. R. McAdams and J. P. Bilisoly). R. N. Watts and J. P Bilisoly in 2,651,599 use a gaseous mixture of steam and 0.01-10 wt. per cent HF at 850° for treatment of deactivated silica-alumina or silica-magnesia catalysts. The total amount of HF used is in the ratio of 0.1-10 lbs. per 100 lbs. of catalyst per 24 hours. The revivified catalyst is reused in the hydrocarbon conversion step without further treatment to remove HF therefrom. A mixture of HF and boric acid in a 3:1 molar ratio is proposed for treatment of silica-alumina catalysts containing about 12 per cent alumina in patent 2,636,845 (R. W. Richardson, J. P. Bilisoly and M. A. Segura).

The recovery of sulfur from sulfur contaminated metallic catalysts is the subject of 2,643,939 (F. W. B. Porter and R. P. Northcott to Anglo-Iranian Oil Co.). The contaminated catalyst is treated at 1,100° F in a current of steam and air. The effluent sulfurous steam and gas mixture is cooled to 60-80° F to effect reaction of sulfur dioxide and hydrogen sulfide and form free sulfur. The mixture is passed into water in which the sulfur is settled.

New Motor Fuel

A new "high performance" automotive fuel has been developed by Phillips Petroleum Co. The new gasoline contains di-isopropyl and alkylate. The new gasoline will be available in the near future at all Phillips stations.

New Petrochemical Plant

Spencer Chemical Co. recently placed an ammonia synthesis plant on stream at Vicksburg, Miss. which incorporated the first plant to produce commercially pure hydrogen by the Texaco partial oxidation process. Spencer now is building three other plants which will employ the same process.

The Vicksburg plant is designed to produce 220 tons per day of anhydrous ammonia, 110 tons of nitric acid, 140 tons of ammonia nitrate solution and 350 tons of an ammoniate aqueous solution used as fertilizer. The plant consumes 15 million cubic feet of natural gas and processes 25 million cubic feet of air daily.

In the Texaco partial oxidation proces, commercially pure oxygen and natural gas are combined under pressure without a catalyst in a converter of simple design. Products of the conversion are essentially hydrogen and carbon monoxide. The carbon monoxide is transferred to a shift converter where CO_2 and additional hydrogen are produced in the presence of catalyst and water. The raw synthesis gas is purified for removal of CO_2 and finally passes through a liquid nitrogen wash from which high purity hydrogen is mixed with nitrogen for subsequent ammonia synthesis.

Foster Wheeler Corp. designed and constructed units for air preparation, shift conversion, carbon dioxide removal and liquid nitrogen wash. The ammonia synthesis plant proper was designed by Spencer Chemical. The air liquefaction and fractionating plant was designed by Air Products Inc.

Rules Proposed for Continental Shelf Leases

A tentative blueprint of rules for leasing of petroleum and natural gas rights on the outer belt of the offshore submerged lands has been issued by Acting Secretary of the Interior Ralph Tudor.

The blueprint, which is elaborate and highly technical, is intended to be the starting point toward final regulations covering the leasing of continental shelf areas.

"We are specifically inviting petroleum companies, coastal states and the general public to make comment on these proposed regulations," says Secretary Tudor. "After the comments come in, a revision of these proposed rules and regulations can be expected, and then the final issuance of them."

The proposed regulations, which leave a number of questions about offshore operations unanswered, are based largely upon government leasing of public lands. In essence, the proposals are for conveyance of oil and gas rights to the highest bidder, with requirement that the royalty payment, upon finding petroleum, is to be no less than 12.5 percent.

The maximum size of leases is pegged at 5,760 acres, a figure much smaller than first suggested by oil company attorneys, who gave their ideas in detail before the proposed regulations were put out. Oil companies are likely to ask for larger areas in view of the high costs of marine operations.

Under the regulations, existing leases on the offshore submerged lands let out before the enactment of the Submerged Lands Act of 1953 are confirmed, but they must conform to the regulations adopted except as regards the area, royalty and rental.

The regulations tentatively proposed make no attempt to draw the boundary between the outer belt of the offshore lands, now the property of the federal government, and the inner belt, which is under control of the respective states. This boundary is certain to remain a problem, although it may not cause postponement of the leasing of either federal or state lands.

Pipe Line Heating Bulletin

A new eight-page bulletin on heating pipe lines has been anonunced as available from the General Electric Co., Schenectady 5, N. Y. Designated GEA-5095A, the publication describes the numerous pipe line applications of G-E Calrod tubular heaters in industry. The bulletin provides a comprehensive chart which shows the heat losses of vertical, solid, smooth surfaces of various metals.

Brazil's Petroleum Council

(Continued from page 86)

186,426 to 195,851 tons. In addition, 17,409 tons of crude were imported in 1953.

In 1952 Dutch West Indies supplied 45 percent (1,447,473 tons) of Brazil's imports of fuel and diesel oils, Venezuela 44.8 percent (1,424,888) and Trinidad 9.5 percent (301,440). As regards gasoline, 49.7 percent (1,195,520 tons) came from Dutch West Indies, 38.3 percent (945,311) from Venezuela and 10.2 percent (230,885) from Trinidad.

In December an Indonesian mission visited Rio de Janeiro to open negotiations for a reciprocal trade agreement with Brazil through which the latter would receive petroleum in exchange for her products. A representative of the Peruvian government suggests that considerable trade might be established between the free ports of Iquitos and Manaus, facilitating increased production of Peruvian oil, which Brazil is anxious to import.

General Juarez Tavora, at a recent press interview in Porto Alegre, expressed the fear that Brazil will have to face a serious oil shortage within the next five years. The Petrobras clauses, in his opinion, should be more flexible in order to attract private enterprise and ensure the maximum possibility of success for Brazil's oil industry. As prospecting requires so many technicians and such a diversity of equipment, outside groups might conveniently have been allowed to participate. Referring to the cost of research, the General said 16 million cruzeiros (U.S. $880,000) had been spent on drilling 4,000 meters in the Amazon region. Brazil, he concluded, is divided into approximately 300 "oil areas" and total drilling to date is not sufficient to cover one of them.

Commencing January 1, 1954, the proprietors of motor vehicles are required to pay the additional taxes imposed under the Petrobras law. Cars, lorries, tractors, launches and aircraft are all liable in accordance with the scale of charges drawn up by the Petroleum Council. Receipts for the tax will be exchanged in due course for bonds or shares in Petrobras.

In December, President Vargas, replying to a memorandum from the Petroleum Council, instructed the latter to proceed with negotiations to install a refinery to produce asphalt in Brazil. The project is sponsored by Standard Oil Co. of California and its subsidiary, International Bitumen Emulsion Corp. Dr. Plinio Cantanhede, president of the Council, said in his memorandum that paraffin will be produced at Mataripe in sufficient quantities to meet market requirements. As regards solvents, the Council hopes to make these available in Brazil, either from the government refineries or by assisting private enterprises technically. Imports of solvents increased from 19,617 tons in 1948 to 87,292 in 1951, but the supply is far short of the demand while imports of asphalt are costing $275,000 annually.

The Standard Oil project provides for installing plant in Sao Paulo, with an annual capacity of 90,000 tons of asphalt. For raw material it would use crude oil from the Boscan field, in the Lake Maracaibo zone of Venezuela. The total expenditure is estimated at U.S. $2,200,000, including $900,000 for imported materials. The company is prepared to advance the latter amount, to be repaid in five years, provided the Council, or Petrobras, signs a contract to buy at market prices 2,000 barrels of Boscan crude daily during the five years. The oil would be carried in Brazilian tankers.

Dr. Cantanhede estimates the resultant annual economy at about $4,300,000, while the local price of asphalt would be reduced 50 percent. Distribution to consuming centers would be by tank truck to avoid the use of costly steel drums.

The Brazilian Air Force is now carrying out an aerial photographic survey of the Santa Cruz de la Sierra oil zone on behalf of the mixed Brazil-Bolivia Petroleum Commission. (See WORLD PETROLEUM, November 1953.)

BOOKS

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ALKYLATION OF ALKANES—Gustav Egloff & George Hulla $22.50

CORROSION HANDBOOK—Herbert H. Uhlig $15.00

CHEMISTRY OF PETROLEUM DERIVATIVES—Carleton Ellis Vol. II $25.00

CONVERSION OF PETROLEUM—A. N. Sachanen $12.00

CHEMICAL ENGINEERS' HANDBOOK—John H. Perry (revised 3rd edition, 1950) $17.00

CORROSION (Causes and Preventions)—Frank N. Speller $11.00

THE CHEMICAL PROCESS INDUSTRIES—R. N. Shreve $10.20

CHEMICAL ENGINEERING ECONOMICS—C. Tyler ..... $ 5.00

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OIL COMPANY STAFF CHANGES

R. L. Lay

ROY L. LAY has ben appointed assistant to E. R. Filley, vice president in charge of the producing department of The Texas Co. Mr. Lay has been manager of the geophysical division at Houston, Texas, since April 1, 1950. His new headquarters will be in New York City.

He joined Texaco as head of a geophysical party in April 1932. During the next ten years he conducted field operations throughout the south and western parts of the United States, as well as in Colombia, Venezuela and Egypt. Mr. Lay is president of the Society of Exploration Geophysicists.

A. J. Singleton

A. J. SINGLETON has been elected executive vice president, California Texas Oil Co. Ltd. He has been a vice president of the company since 1948. Mr. Singleton's career in the oil industry began in 1924 with the Galena Signal Oil Co. (Ireland) Ltd. In 1929 Irish Galena was acquired by The Texas Co., and in 1931 he was appointed managing director of Texaco's English subsidiary in London. Throughout World War II he served as a director of the British Petroleum Board.

In 1945 Mr. Singleton became assistant general manager of The Texas Company's foreign sales division. Two years later, when the company's European interests were acquired by California Texas Oil Co. Ltd., he was made assistant vice president of Caltex. In 1948 he was elected vice president in charge of marketing West of Suez and three years later he was named a vice president and director of the Caltex group, a position he held until his present election.

H. C. Hose

HOWARD E. SLATER, purchasing agent for the foreign production division of Gulf Oil Corp., retired March 1 after 32 years of service. He served with the A. E. F. in World War I as regimental supply sergeant in the field artillery. He joined the Mexican Gulf Oil Co. in Tampico, Mexico in December 1922 as a warehouseman. In 1927 he was transferred to the Venezuela Gulf Oil Co. In 1930 he was transferred to New York as purchasing agent for Gulf's foreign production operations.

H. C. HOSE has been elected vice president in charge of marketing for the California Texas Oil Co. Ltd. He formerly was assistant vice president and general manager in New York in charge of the company's European division. Mr. Hose joined The Texas Co. in 1927 as a field engineer at the Port Arthur works. In 1937 he was transferred to New York City as assistant chief engineer, refining department. From 1939 to 1944 he was assistant superintendent of Beacon research laboratory and in 1944 he was transferred to foreign operations, becoming manager of foreign operations in 1947.

In his present position Mr. Hose will continue to direct the affairs of the European division for Caltex.

J. L. Lenker

LEE BALLARD has been named technical assistant to the industrial products sales manager for the eastern division of Tide Water Associated Oil Co. He joined the company in 1931 in Buffalo as an industrial products salesman, and was made assistant manager in the sales engineering section in 1945.

JOHN L. LENKER has been named general manager of domestic retail and jobber sales for Gulf Oil Corp. He succeeds W. H. Huber, who has been appointed general manager of public relations. Mr. Lenker joined Gulf in 1934 as New York division supervisor of specialty sales. In 1947 he became assistant division manager and later became division manager.

HAROLD G. OSBORN has been elected vice president in charge of manufacturing at Continental Oil Co. He also is a director and officer of Continental Oil Black Co., Continental Carbon Co., Continental Blacks, Inc., Continental Chemical Corp., Cit-Con Oil Corp., Continental Petrochemical Co., Petroleum Chemicals, Inc., and The Lubrizol Development Co.

Joining Continental at Ponca City in 1921, Mr. Osborn has been a vice president since 1946. He was promoted in 1926 to assistant superintendent of the Ponca City refinery and became assistant manager of manufacturing the following year. He was named manager of the manufacturing department in 1936 and was elected vice president in charge of manufacturing in 1946.

B. W. GRANT has been promoted from chief accountant of Texas Petroleum Co. at Bogota to assistant to the manager in the Caracas office. J. O. Canfield was promoted from geophysicist in the Venezuelan division of Texas Petroleum Co. to geophysical supervisor in the Colombian division.

E. G. Dobson, formerly chief petroleum engineer in the Venezuelan division of Texas Petroleum Co., has been promoted to chief engineer in the foreign producing department of The Texas Co., New York.

HENRY C. CORTES has been elected a director of Magnolia Petroleum Co. He will be in charge of research in addition to his duties as assistant manager of the exploration division which consists of the geological, geophysical and land departments. Mr. Cortes joined Vacuum Oil Co. in the geological department. He pioneered the fields of torsion balance and refraction seismograph work and interpretation throughout the Gulf Coast area. He is a past president of the Society of Exploration Geophysicists.

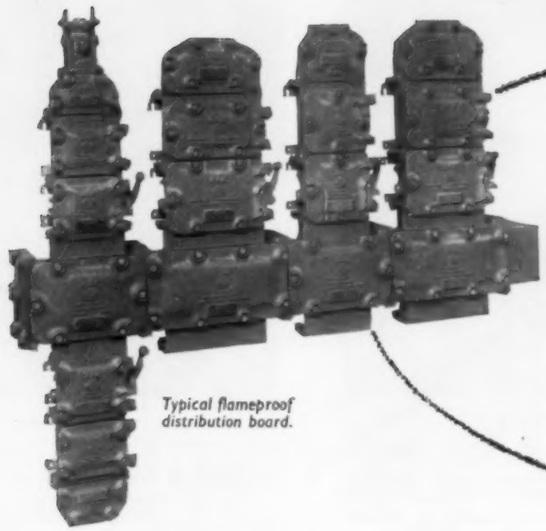
WILBURN T. ASKEW has been appointed general manager of Sun Oil Company's refinery at Marcus Hook, Pa. He succeeds Charles E. Maschal, who died February 17 following a heart attack.

Mr. Askew joined Sun Oil Company in 1931. He was appointed assistant superintendent in charge of gas recovery and alkylation in 1944 and continued in this capacity until his appointment as superintendent of the refinery in 1949. He became assistant manager in July 1952.

JOHN A. MURPHY, chief reservoir engineer for Continental Oil Co., Houston, has been promoted to assistant to vice president. Mr. Murphy joined Continental at Ponca City, Okla., in 1948 as a reservoir engineer, was promoted to supervising engineer the following year, and became chief reservoir engineer in 1950. Succeeding Mr. Murphy as chief reservoir engineer is Wallace W. Wilson, who has been assistant chief reservoir engineer. He will move his headquarters to Houston from Ponca City.

ARTHUR W. BROWN has been appointed manager of the employee relations department of Esso Standard Oil Co. to succeed William B. Maloney who has been transferred to Standard Oil Co. Mr. Brown has been assistant employee relations manager of the company's Bayway refinery.

EZRA W. DRAKE has been appointed senior drilling administrator at Tia Juana, Venezuela, by Creole Petroleum Corp. He formerly was supervisory petroleum engineer at Maracaibo.



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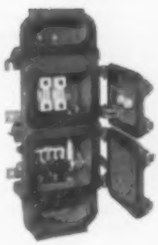

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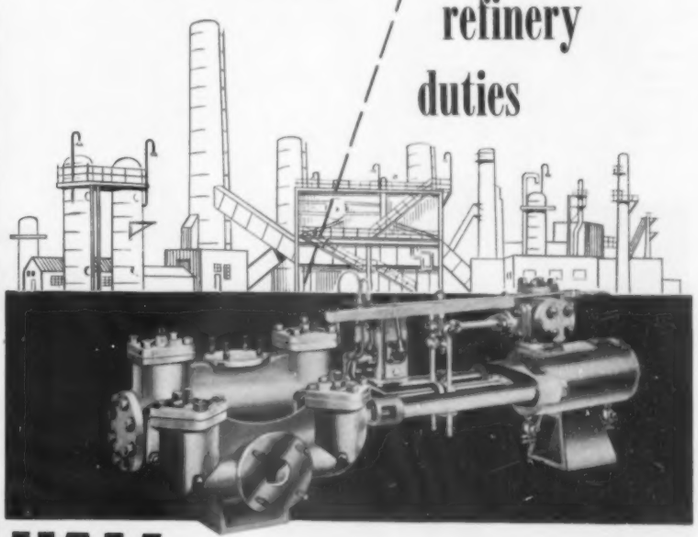

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J. O. Fifer

C. J. Guzzo

R. B. Bossler

JULIUS O. FIFER has been transferred to operations in the Philippines by California Texas Oil Co. Ltd. The appointment, made in connection with the new Caltex refinery under construction at Batangas, south of Manila, involves residence in the Philippines, where Mr. Fifer becomes vice president and director of Caltex (Philippines) Inc. Mr. Fifer's work began in the oil business in 1925 and has been highlighted since by research and refining responsibilities in Texas, at Bahrain in the Persian Gulf, and New York.

JOHN A. RITTER, superintendent of the operating department for Sun Oil Company's southwest division, retired March 15 after 31 years of Sun service. A. S. Rhea succeeds him. Mr. Rhea has been chief petroleum engineer and assistant superintendent, operating department. F. G. Prutzman assumes Mr. Rhea's former duties and the title of division petroleum engineer. He has been assistant chief petroleum engineer.

RAYMOND F. HADLEY has been appointed chief engineer, Louis M. Miller assistant chief engineer, and Robert C. Greer, Jr., construction engineer of the product lines department of Sun Pipe Line Co. Mr. Hadley formerly was electrical engineer, Mr. Miller, mechanical engineer, and Mr. Greer, civil engineer.

DR. R. K. STRATFORD, Sarnia, Ont., received the medal of the Society of Chemical Industry, Canadian Section, at the Society's medal meeting in Toronto on February 24. Dr. Stratford is scientific advisor to Imperial Oil Ltd. The medal is awarded every two years for outstanding contributions to the chemical industry and chemical affairs in Canada. Dr. Stratford was introduced for the presentation by Dr. H. B. Speakman, director of the Ontario Research Foundation.

C. J. GUZZO has been elected a vice president of the Gulf Oil Corp. and Gulf Refining Co. He will continue in the domestic marketing department, making his headquarters at Pittsburgh. A veteran of 40 years of service, Mr. Guzzo has been division general manager of the company's New Orleans sales territory since 1949.

PAUL L. LYONS, Tulsa, exploration manager of Anchor Petroleum Co., has been elected president of the Society of Exploration Geophysicists. Roy F. Bennett, Oklahoma City, chief geophysicist of Sohio Petroleum Co., will be vice-president. Hugh M. Thralls, Tulsa, vice-president of Seismograph Service Corp., is the new secretary-treasurer. Terms of office will begin April 16 at the close of the society's annual meeting in St. Louis.

Dr. Milton B. Dobrin, Magnolia Petroleum Co., Dallas, continues in the two-year term as editor. Roy L. Lay of The Texas Co. is a member of the 1954-1955 executive committee with the new officers.

DR. A. W. NAUSS has resigned as vice president of Link & Nauss Ltd., Calgary, to take over the active management of Scurry Oils Ltd. His former firm has changed its name to Link, Downing & Cooke Ltd.

John A. Downing has succeeded Dr. Nauss as vice president and D. Y. Cooke is secretary-treasurer.

WALLACE F. ARMSTRONG, manager of the Houston plant of Ethyl Corp., has been appointed assistant general manager of manufacturing. He is succeeded by Glenn O. Hayes, acting assistant manager at the Baton Rouge plant. Melvin C. Hudgins becomes assistant manager of the Baton Rouge plant and James J. Bergin assistant manager of the Houston plant.

ROBERT B. BOSSLER, vice president and chief engineer for Brundred Oil Corp., has been named director of production research for the Pennsylvania Grade Crude Oil Association. He will have headquarters in Bradford, Pa., where the Association has a production research laboratory. Mr. Bossler is a nationally known authority on production of petroleum by secondary recovery. With the Brundred Corp. since 1935, he has had charge of its engineering in development and operation of properties by water-flooding and air and gas drive in Pennsylvania, Kentucky and Kansas.

JOE B. HUDSON, for the past year acting area geologist for Humble Oil & Refining Co. in California, has been elected vice president of Monterey Oil Co. in charge of exploration and production operations. He joined Humble in 1934 and shortly thereafter was loaned to Lago Petroleum Co. at Maracaibo, Venezuela. He returned to Humble in 1937.

JOHN H. PURNELL has been appointed director of public relations for Cities Service Oil Co. He has been in charge of publications and news since he joined the company in 1951. John Steiger, editor of *Empire* magazine, will be superintendent of publications and news in the public relations department.

N. H. MARSH, manager of the export sales department of General Petroleum Corp., retired March 1 after 42 years' service. Mr. Marsh, who grew up in the Pennsylvania oil fields, first went to work in the oil industry in 1908 at a production office in Coalinga. He joined General Petroleum in March 1912 at Los Angeles in the sales department. In 1934 he was appointed manager of the export sales department, which position he has held since.

Dr. R. K. Stratford

W. F. Armstrong

N. H. Marsh

A. M. Gee

H. W. Stewart

A. M. GEE, who has been with The Ohio Oil Co. for almost 34 years, retired April 1 as director and general counsel. He is succeeded by Hal W. Stewart, assistant general counsel.

Mr. Gee joined The Ohio Oil Co. in 1920, handling the company's legal affairs in the Rocky Mountain area at Casper. In 1927 he was transferred to Tulsa. In 1932 he was appointed general counsel and he was elected a director in 1941.

Mr. Stewart started his Ohio Oil career in 1922 as attorney at Shelby, Mont. He was transferred to Casper, Wyo. two years later as assistant division attorney, serving under Mr. Gee.

HAL G. MULLEN, of 107 Highland Ave., Ridgewood, N. J., manager of industrial products sales for the eastern division of Tide Water Associated Oil Co., retired March 31 after 30 years of service with the company. Mr. Mullen represented the company in South America in 1925, and upon returning to this country was appointed industrial sales supervisor. He became manager of the industrial products sales department in 1936.

R. P. HUGGINS, vice president of Gulf Oil Corp., has transferred from Houston to Pittsburgh where he will direct the crude oil purchases and products supply operations of the company. The newly-formed department will be known as the crude oil and products supply department.

DR. JOHN W. FREY retired as director of the division of marketing of the American Petroleum Institute March 1. Adam J. Rumoshosky is his successor. Headquarters of the division has been transferred from Washington to New York.

E. L. MOUNT has been promoted to regional geophysicist for Continental Oil Company's central region, with headquarters in Oklahoma City. He has been with Conoco since 1926 in the southwest and Rocky Mountain areas and in Mexico.

H. Jeffries

S. H. McManus

HARRY JEFFRIES, since 1950 the comptroller of Sinclair Oil Corp., has been elected vice president. S. H. McManus, formerly assistant comptroller, has been elected comptroller to succeed Mr. Jeffries, while O. P. Thomas has been named assistant comptroller, succeeding Mr. McManus. Mr. Jeffries, who joined the Sinclair organization in 1919, has held various positions with Sinclair Oil Corp. and served as comptroller and director of Sinclair Refining Co., marketing and manufacturing subsidiary, from 1951 through 1953.

SAMUEL J. MATHIS has been appointed assistant district superintendent at Salina, Venezuela by Creole Petroleum Corp. He formerly was supervisory engineer in that area.

D. L. CORNELL has been named chief engineer of Tuscarora Pipe Line Co. Ltd. Mr. Cornell is a graduate of West Virginia University and has been with Tuscarora approximately eight years.

PAUL N. TEMPLETON has been elected a director of Magnolia Pipe Line Co. Mr. Templeton, who has been with the Magnolia organization for more than 28 years, is secretary of the company and tariff man.

D. J. WINTER and D. L. Campbell have been appointed vice presidents of British American Oil Co. Mr. Winter becomes vice president, marketing, and Mr. Campbell becomes vice president, manufacturing.

Mr. Winter joined the marketing department of B-A's Manitoba division in 1935. In 1947 he was appointed regional sales manager for Ontario and since 1951 has been sales manager for Canada.

Mr. Campbell joined British American Oil at Moose Jaw refinery in 1934. He was manager of Calgary refinery before being promoted to manager of refineries in 1948. For the past three years he has been manager of manufacturing.

D. J. Winter

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Billions Spent at Service Stations

Americans are spending more money at gasoline stations than in clothing stores, in restaurants or in furniture and appliance stores.

This is according to the report of the Commerce Department which said 1953 retail sales of gasoline stations in the United States amounted to $10,520 million. A year earlier, the total was $9,978 million.

Americans spent three times this, however, or $33,382 million, for new and used automobiles, the report shows.

The service station figures include oil and antifreeze, lubrication, motor tune ups, tires and parts as well as gasoline.

By months, the big gasoline service station sales are in the summer. They reached $917 million in July of 1953. The low point was in January, when sales came to $779 million.

In 1952 the high point was August, at $915 million. The low was February, $716 million.

To End FPC Control of Interstate Gas

The Senate of the United States on March 15 approved a bill previously passed by the House of Representatives exempting natural gas companies engaged in intrastate operation from regulation by federal authority.

The effect of the bill is to nullify a court decision rendered in 1950 which held that the East Ohio Gas Co., although doing business entirely within Ohio, was subject to regulation by the Federal Power Commission because some of its gas supply came from outside the state.

Worthington Bulletin

A new bulletin, WP-1099-B61, on industrial equipment, is being offered by Worthington Corp., Harrison, N. J. The bulletin contains information about special features, types, sizes and capacities of Worthington's various product lines of industrial equipment.

J. M. Sitler, director of purchases of Esso Standard Oil Co. who is retiring soon, was the honored guest at the New York Chapter of Nomads' March meeting at the Hotel Biltmore in New York City. Over two hundred Nomads and their friends were on hand to pay him their respects. In the photograph Mr. Sitler (fourth from left) is shown with (left to right) Joe L. Comer, The William Powell Co., New York Chapter of Nomads' sergeant-at-arms; A. J. Kelly, general purchasing agent, Esso Standard Oil Co.; Ward Casterton, Mr. Sitler's predecessor as director of purchases for Standard; and Norris L. Boulden, International General Electric Co., New York Chapter of Nomads' president.

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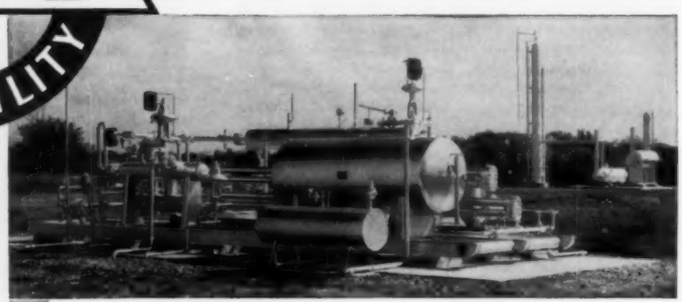

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New Marine Geophone

Southwestern Industrial Electronics, Inc., Houston, has announced the development of the S-16-WC Marine Geophone. The hermetically-sealed detectors are gimbal-mounted in special bearings. Good electrical connections are assured by the use of spring-loaded, continuous wipers which maintain contact through 360 degree rotation of the detector assembly. The contact points are made of precious metal to avoid corrosion and wear problems.

The cable conductors are carried in milled grooves in the inner assembly and thus are protected from abrasion and the possibility of shorting. The outer case is a seamless bronze sleeve with threaded ends to accept the cable bell housings. The complete assemblies have been pressure-tested to a depth of 250 feet in salt water.

NGAA Sponsors Analysis Project

Seventy six plant and research laboratories of 48 oil companies and nine commercial laboratories are participating in a hydrocarbon analysis project sponsored by the Natural Gasoline Association of America. The laboratories are analyzing a synthetic natural gasoline sample. Exact composition of the sample is known only by the blender. While most of the analysis will be made by low temperature distillation, 14 laboratories will also use mass spectrometry, 15 will use infrared, one the fraction method and one by absorption index. A. J. Miller, Phillips Petroleum Co., chairman of the NGAA Fractional Analysis Committee, is in charge of the project. The same group later will analyze a natural gas sample.

Errol J. Hesser

Errol J. Hesser, district superintendent of the southern district for the British-American Oil Producing Co., was fatally injured in an automobile accident in Houston on March 3. He had been active in the oil industry since he was 17 years old. He was general superintendent of Rowan Drilling Co. for nearly 14 years prior to his joining British-American in 1948.

A. Ludlow Clayden

A. Ludlow Clayden, former head of Sun Oil Company's automotive laboratory at Marcus Hook, Pa., died February 23 in Halifax Hospital, Daytona Beach, Florida. He was 71. An authority on fuels and internal combustion engines, Mr. Clayden retired last July after 31 years with Sun.

Harbison-Fischer Appoints Three New Representatives

Harbison-Fischer Manufacturing Co. of Ft. Worth, Texas, has announced the appointment of three new sales representatives to serve three major oil producing areas with Harbison-Fischer pumping equipment.

Don Dye, who will represent the company in its Houston territory, joined the Harbison-Fischer sales staff after working in the production departments of The Texas Co., Gulf Oil Corp., Humble Oil and Refining Co., The Pure Oil Co., and Wilson Supply Co. Sam Johnson, whose headquarters will be in Midland, Texas, was associated for many years with producers, contractors, suppliers and manufacturing companies in West Texas, the Panhandle, and north Texas.

W. R. Forcum, who will work out of Denver, Colo., has had extensive experience in the Rocky Mountain region. He has represented The Guiberson Corp., Gearench Manufacturing Co., and Grove Regulator Co.

Harbison-Fischer's most recent development is the new H-F "double-displacement" insert pump which offers advantages of a large volume tubing-type pump with additional operating advantages of a sucker rod pump. It is recommended for large-volume wells usually produced by tubing or casing pumps which require frequent pulling jobs, and for wells where it is desirable to lift more fluid or pump the same amount of fluid at a slower strokes-per-minute rate.

Don Dye

L. E. Johnson

W. R. Forcum

Texaco Plant Expansion

The Texas Co. has begun construction on a Platforming unit, an alkylation unit, and the expansion of other refining facilities at its Eagle Point works, Westville, N. J. The Platforming unit will have a rated charge capacity of 12,000 b/d. The alkylation unit is designed to produce 1,926 barrels of alkylate per operating day. Expansion plans call for the construction of an additional steam generator with a rated capacity of 275,000 pounds per hour, as well as additional water cooling facilities.

Davison Research Appointments

Dr. P. L. Veltman has been appointed director of research and development for Davison Chemical Corp. He was manager of the Baltimore laboratories. Ralph E. Hope, formerly manager of research engineering, has been made an assistant director, his duties including management of the laboratories. L. L. Baral has succeeded him as manager of research engineering. W. K. O'Loughlin has also been named an assistant director. He was formerly manager of the development department, in which position he is succeeded by O. D. Myrick.

Edwin M. Gocker, formerly staff assistant to Dr. Bachman, has been made manager of the research statistics department, a new post. Luther O. Young is manager of the application research department, another new post. Dr. Bachman's staff assistants are C. D. Helm and A. J. Antonious.

Dresser Report

The fiscal year 1953 ended a moderately successful business period for Dresser Industries, H. N. Mallon, president, stated in Dresser's annual report for 1953. Substantial recovery in the last six months of 1953, after a first half during which operations were somewhat below capacity levels and net earnings were below normal, accounted for this improved position. Net earnings after taxes were $5,124,310 on sales of $128,869,381. This compares with net earnings of $5,766,596 on sales of $127,356,277 for the 1952 fiscal year. On a per common share basis, net earnings for 1953 were $3.80 as compared with $4.28 in 1952.

Casing Scratcher Positioner

The Duraflex Co. of Houston, manufacturers of casing centralizers, have introduced a new stop ring for positioning scratchers and centralizers on casing in lieu of welding. A slotted ring is placed over the casing and when the desired position is determined, slip-type wedges are driven into the ring slots to seat between the casing and the metal ring. The wedges have extremely hard surfaces that are grooved to provide maximum gripping quality. Their soft cores permit them to conform to the round casing exterior. Tests have withstood reversal weights in excess of 10,000 pounds.

Hammond Iron Appointment

The appointment of Max G. Walker as sales manager for the southeastern United States is announced by Ralph E. Kramer, vice president in charge of sales for Hammond Iron Works. Mr. Walker spent over six years as Chicago district sales manager for the Murphy Diesel Co. of Milwaukee. He was also identified with construction activities in petroleum and mining industries of South America. He will make his headquarters at the new Hammond Iron Works plant at Birmingham, Alabama.

Threatened Attack On Depletion Allowance

Although the House Ways and Means Committee of the United States Congress, in reporting its tax measure for the coming year, made no change in the existing depletion allowance of 27½ percent to producers of oil and gas, two members of the Senate have announced their intention of proposing a reduction in this incentive when the bill reaches that body. These are Senators John J. Williams of Delaware and George Aiken of Vermont. Both are influential members of the upper house and the former is on the Senate finance committee which considers tax matters before they go to the floor. Unless the committee recommends a change, the only possibility of obtaining action would be by attacking the provision in the course of debate. The likelihood of success for such an attempt is considered slight as Congress has repeatedly approved the existing provision.

The petroleum industry is practically unanimous in its opposition to any reduction on the ground that it would discourage exploration and the building up of reserves. Serge Jurenev of Continental Oil Co. has forecast that tampering with the depletion allowance could add one, two or three cents to the price of a gallon of gasoline.

Supreme Court Upholds Tidelands Act

Refusal of the Supreme Court of the United States to entertain a motion by the state governments of Alabama and Rhode Island attacking the legality of an act of Congress quitclaiming to coastal states the ownership and control of offshore waters including the right to drill for oil and gas, apparently has finally ended a contest that has extended over the past decade. While the state of Arkansas still has an action pending in a lower court which attacks the validity of the law, the sweeping nature of the Supreme Court's decision handed down on March 15 was so definite that no later modification is expected. The court's opinion was approved by a vote of six to two. Chief Justice Warren abstained, having been active in support of the legislation as governor of California before his appointment to the court. Two other justices, Black and Douglas, upheld the claim of the two applicant states for a hearing without attemping to pass on the validity of the law.

The finding of the six justices upholding the so-called Tidelands Act quoted previous decisions declaring that the right to dispose of property belonging to the United States "is vested in Congress without limitation," and that it was for Congress, not the courts, to deal with administration or disposal of public lands.

Appointed McCullough Sales Engineer

W. E. Swafford has been appointed sales engineer at the Lake Charles, La. branch of the McCullough Tool Co. Previous to his new appointment Mr. Swafford had been working as an operating engineer out of McCullough's New Iberia, La. branch.

Dr. P. L. Veltman

M. G. Walker

INTERNATIONAL NEWS AND NOTES

New Assam Well On Production

Nahorkatiya No. 1, first well to strike oil deep in the rocks underlying the alluvium of the Brahmaputra valley in Upper Assam, was put on regular production in February by the Assam Oil Co. Output is about 500 barrels of crude oil daily. The oil will be refined at Digboi. An 8-inch pipe line to the refinery will be laid later this year.

Nahorkatiya Well No. 1, which began drilling in May 1952 and took more than a year to complete, went to a total depth of 11,715 feet. A second well, located on the south bank of the Burhi Dihing river about a mile from the original discovery well, was started in December and is now approaching its objective depth of 10,500 feet. Sites for further deep wells have been chosen. A new road through jungle and forest was opened in March connecting the Nahorkatiya area with the main Digboi oilfield, about 20 miles to the northeast.

Austrian Motor Fuel Improved

Tetraethyl lead is now being added to Austria's 760-gram gasoline, to reach a guaranteed over-70-octane level. A trend toward 750-gram gasoline has recently been evident in Vienna.

Gasoline presently sold by the OROP distributors (Soviet-controlled outlets) has an initial boiling point between 37 and 40 degrees centigrade. Some 20 percent is distilled at 100°C, and the final boiling point is 250°C.

The BBA mixture (benzin-benzol-alcohol) now on the market is made up of 77.5 percent gasoline, 7.5 percent benzol, and 15 percent alcohol; octane rating is between 77 and 79, and 770 grams per liter the specific weight. Western Austrian provinces seem to prefer a benzin-benzol mixture without alcohol, of 75 octane and 796 grams specific weight, i.e. 70 percent gasoline mixed with 30 percent benzol.

Consumption of Oil Products

Fuel oil consumption is climbing steadily in Austria, after dropping in 1948 and 1949 from the 1947 total. In metric tons the figures are:

1947	197,406	1950	240,583
1948	126 918	1951	389,667
1949	124,190	1952	483,477

The 1952 total was distributed as follows:

Power plants	63,569 metric tons
State RR system	30,288 metric tons
Industry	349,713 metric tons
Small customers	39,907 metric tons

A 20 percent increase is expected during 1954.

Gasoline consumption in 1952 decreased to 22 percent below 1951, but this year it is expected to rise to 200,000 metric tons.

Diesel fuel consumuption reached four times its prewar average in 1951, and this year will probably rise to 245,000 tons—86 percent of it for trucks and tractors, six percent for heating, and eight percent for industrial uses.

Italian Trade Agreement

A trade agreement between the USSR and Italy, signed in October 1953, provides for Soviet delivery by October 1954 of 200,000 metric tons of mineral oil products and 100,000 of naphtha. Italy is to deliver in turn three ice-breakers, three fishing boats and 15 tow-boats of 150 hp. It is rumored that the Soviet plans also to order tankers from Italy. It has offered an annual delivery volume of 600,000 metric tons of oil, as well as the erection and maintenance of a storage center for oil on the Ligurian seacoast.

The USSR has also ordered 40 tankers from Scandinavian shipyards.

Middle East Production

Crude oil production of Middle East areas for January 1954 is reported as follows:

	Long Tons
Iraq Petroleum Co. Ltd. (Kirkuk field)	2,253,782
Basrah Petroleum Co., Ltd. (Zubair field)	276,428
Mosul Petroleum Co., Ltd. (Ain Zalah and Butmah fields)	107,102
Qatar Petroleum Co. Ltd.	382,012
Kuwait Oil Co. Ltd.	3,326,758
Aramco (28,974,112 U. S. bbls.)	3,915,420
	10,261,502

Australian Company Expands Drilling Program

West Australian Petroleum Pty. Ltd., which is owned by the Caltex and Ampol companies, is greatly expanding its drilling program for 1954, according to a statement by Minister of Mines Lionel Kelly, and will spend upward of $6,000,000 on exploration and test drilling during the year. In addition to further development drilling in the vicinity of last year's discovery near Exmouth Gulf, 11 adidtional tests will be made in other parts of its concession including the Fitzroy Basin about 700 miles northwest of the initial discovery.

Equipment Deliveries for Alaska Pipe Lines

Heavy construction equipment has started arriving in Alaskan ports for the 621-mile $29,000,000 Haines to Fairbanks pipe line. Joint venture firms awarded the pipe line contract are Marwell Construction of Vancouver, Williams Brothers Construction Co. of Tulsa, and McLaughlin, Inc. of Great Falls, Montana. Two hundred eighty miles of line will cross Canadian territory in British Columbia and the Yukon Territory. Stewarts & Lloyds of London have shipped 5,500 tons of pipe to Haines, the southern end of the line. This first consignment is expected to cover about 80 miles of the pipe line route. Additional shipments will follow.

An Italian View of the Oil Industry

A condensed story of the development of the world oil industry has been written by an Italian lawyer, Avv. Fernando de Mattia, under the title "Il Mervigliosa Mundo del Petrolio" (The Marvelous World of Petroleum). It deals briefly with the story of petroleum from its legendary beginnings to its present day status as the most indispensable of industries. The material for the work has been drawn from a wide variety of sources and its most admirable quality is the author's great enthusiasm for his subject. It is obviously written for the technically uninformed and particularly for Italian readers.

Il Mervigliosa Mundo del Petrolio, by Avv. Fernando de Mattia; 228 pages; Naples, Italy, 1953.

French Exploration Activity

In an address before a geological group at Hanover, Dr. Trumpy of the French Petroleum Institute reported that 60 drilling rigs are at present in operation in France and French colonies. In addition to the activity concentrated in southeastern France, exploration work is under way in northern Africa and the northern part of the Sahara, near Dakar, in Togo, the Cameroons, Gabun and Madagascar. Altogether the French have drilled more than 1,000 deep wells, he stated.

Elected Canadian Gulf VP

E. D. Loughney

E. D. Loughney has been elected a vice president of the Canadian Gulf Oil Co., a subsidiary of the Gulf Oil Corp.. He has been general manager of Canadian Gulf at Calgary since 1951 and will continue to be responsible for the company's oil exploration and production operations in Canada. According to published reports of Gulf Oil, the company had some 6.4 million acres of undeveloped leases and options in western Canada and had 195 producing wells in Alberta at the end of 1952.

Somaliland Survey Begun

More than $250,000 worth of geophysical equipment and supplies belonging to Rogers Geophysical Co. was shipped from Houston recently to Mogadiscio, Italian Somaliland, where Rogers will make surveys of an area of about 20,000 square miles in the East African jungle. A Rogers crew of 15 men will fly to Africa in time for the arrival of the equipment. About 40 Somaliland nationals will be employed.

About 1,700 different items were included in the equipment loaded on the *SS Borneo*. Equipment included three heavy shot hole rigs, three water trucks, seven combination water and gasoline vehicles, a truck with the geophysical instruments, five trailer houses, two water tank trailers, a repair trailer large enough to drive a truck into, a bulldozer and 220 boxes of food and other equipment.

J. R. Monkhouse, left, and Sam D. Rogers, president of Rogers Geophysical Co., supervising the loading of equipment for making geophysical surveys in East Africa.

Sales of British Built Equipment

Statistics published by the Council of British Manufacturers of Petroleum Equipment show that orders placed by oil companies with manufacturers in the United Kingdom during 1953 amounted to £67,140,000 ($187,992,000). This is a substantial drop from 1952, the peak year, when such orders totaled £91,400,000 ($255,920,000). The difference is attributed to the fact that in 1952 refinery expansion in Great Britain was at its height, while now most of the orders for new refineries have been placed and trade has returned to normal proportions. Sales for the final quarter of 1953, recently compiled, were £15,670,000 ($43,876,000).

German Demand at Record Level In 1953

Revised 1953 figures show crude oil production of Western Germany as 2,188,716 metric tons. In addition, 4,458,168 tons of crude were imported during the year, making the total crude supply 7,646,884 tons, an average of roundly 154,000 barrels daily. Total imports of crude and products amounted to 5,178,852 tons, bringing this figure above five million for the first time.

East Germany Oil Imports

Over 100,000 metric tons of crude was shipped by the Soviets from Austria in 1953 to East Germany. During the final quarter, 90,000 metric tons of diesel fuel in addition were shipped from Romania and Austria.

Yugoslavia Plans Natural Gas Lines

Construction preliminaries on three gas pipe lines are currently being pushed in Yugoslavia. Three gasoline plants and various butane-propane centers may be built. Gas reserves are now estimated at over six billion cubic meters.

M. L. Margenau

Elected Badger Pipe Line President

M. L. Margenau of Bartlesville, Okla. has been elected president and director of Badger Pipe Line Co. He has been director of public relations of Cities Service Oil Co. (Del.) since 1946. G. R. Preston, assistant treasurer of Cities Service, and Glen H. Giles of Sinclair Pipe Line Co. were elected directors.

Badger Pipe Line Co. was organized recently by Sinclair Pipe Line Co., Cities Service Oil Co., the Pure Oil Co. and The Texas Co. to construct a products line from Chicago to Madison, Wisconsin. The line is scheduled to be put into operation late this year to serve metropolitan Chicago, Rockford, Ill., and Madison, Wis., areas.

New Completion Method

A new method of tubing type well completion, using full size gas jet perforating charges, has been developed by the McCullough Tool Co. This new method utilizes any one of the three regular McCullough glass jet perforators with steel strip carriers. The perforator is attached to the bottom of the production tubing by means of a special connection and is run in the well on the tubing to the desired depth. The surface control equipment is then installed and the flow lines hooked up.

The glass jet perforator is fired by means of a McCullough electric firing probe which is run through the tubing. After firing, the electric firing probe is removed from the well on the electric wire line. The expendable steel strip carrier remains in the well. The well flows through the open-ended tubing entirely unrestricted, since no operating mechanisms are left in the hole.

Use of full size perforators gives maximum jet power and deepest penetration. Nearly any length of steel strip carrier may be used, with anywhere from one to four shots per foot. The longest strip to be run to date has been 154 feet. The strip carrier may be loaded full length, or sections may be left unloaded so as to perforate only selected intervals. As much as 25 feet of blank section has been left in running long strip carriers. The entire perforating job is accomplished at one time, even multiple-zone completions, because all shots are fired simultaneously. And, since all surface control equipment has been previously installed, the well is in condition to start producing immediately without lost time complications caused by excessive pressures.

After perforating, the steel strip carrier remains in the hole, attached to the outside of the bottom of the tubing. It does not break up into small pieces, and since it has no appreciable bulk, it does not restrict production in any way. Any time the tubing is pulled from the well, the strip will be retrieved.

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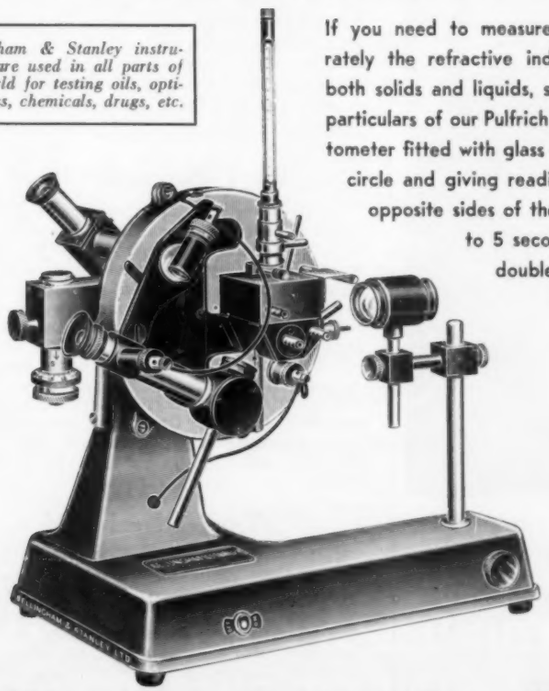

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Arrow Drilling Company Sold

Arrow Drilling Co. of Oklahoma, its subsidiary the Arrow Drilling Co. of Texas and the Arrow Drilling Co. Canada Ltd., have been sold to Henry Rogers Benjamin, a grandson of H. H. Rogers, a founder of Standard Oil, and a group of associates. The organization is to be under present management with the exception that W. S. Churchill retires as president, becoming chairman, with the other officers moving up in their normal lines of promotion. I. H. Patton, Jr., will be president; M. D. McBride, executive vice president; D. L. Edmiston, vice president, production and land; G. J. Churchill, vice president, drilling equipment and operations; S. M. Blevens, vice president, contracts; Jerry D'Arcy, manager district A, Tulsa; Louis Roark, manager district B, Odessa, Texas; Lloyd Hanson, manager district C, Tyler, Texas; and James Parker, manager district E, Denver, Colo. The Arrow Drilling Co. Canada Ltd. is headed by T. P. Bartlett, manager, with Frank Greenwood in charge of contracts at Calgary.

Petrochemical Tanker

The Standard Oil Co. of California tanker *R. G. Follis* is to be refitted with special equipment to facilitate shipment of petrochemicals marketed through the Standard subsidiary, Oronite Chemical Co. She will make regular intercoastal runs between Richmond and El Segundo refineries and the Gulf and East Coasts. On the return trip, she will carry eastern blending stocks and chemical raw materials.

To Build Sulfur Plant

A contract for design and installation of a sulfur recovery unit at its Houston, Texas refinery has been signed with The Ralph M. Parsons Co. of Los Angeles, Sinclair Refining Co. has announced. The unit will produce 30 tons of sulfur a day from hydrogen sulfide recovered from refinery gas streams. The Houston unit will be the sixteenth of its type engineered and constructed by the Parsons organization.

C. R. Dodson

Joins National City Bank

Charles R. Dodson has joined The National City Bank of New York as petroleum engineer. Until recently he has been a partner in the consulting firm of Stanley, Stolz and Dodson, Los Angeles.

In his 17 years' experience in oil he has served as head petroleum engineer for the northern district, Standard Oil of California, and head of the petroleum engineering department for the University of Southern California.

Unifining Process

Universal Oil Products Co. and Union Oil Co. of Calif. have announced that the Unifining process for the purification of petroleum distillates is now available for licensing. The process is particularly advantageous for pretreating certain feed stocks before they are processed in a UOP Platforming unit, whose excess hydrogen makes an economical source of hydrogen for the Unifining unit. Other applications of Unifining include the upgrading of catalytic cracker charge oils, kerosines, burner and diesel oils, shale oil distillates, jet fuel stocks, and specialty products. A specially-developed cobalt-molybdenum type catalyst is used.

Ethyl Mercaptan Plant

Construction of a new petrochemical plant to produce methyl mercaptan was announced recently by Pan American Refining Corp. The unit will be at Texas City. It will have a capacity approaching five million pounds per year and will be the first multi-million pound plant to produce high purity methyl mercaptan synthetically from hydrogen sulfide and methanol. The equipment will be capable of producing other mercaptans such as ethyl mercaptan and propyl mercaptan, although initial production will be limited to methyl mercaptan. Operations are expected to begin during the last quarter of 1954 and full capacity production is expected by January 1, 1955.

Tanker Keel Laid

Keel has been laid for the fourth of four new tankers being built for Tide Water Associated Oil Co. during 1954. This is the second of twin 16,000 dwt tankships to be built for the oil company's use on trans-ocean and coastal runs in the Pacific Ocean. The work is being done at the yards of Bethlehem Sparrows Point Shipyard, Baltimore, Md. Delivery of the finished ship is expected to be made in October. The other two tankers being built for the company are for Gulf of Mexico and Atlantic Ocean use.

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Cost of Drills (3)	6,450.00
Other Costs, including bits	9,750.00
Month Total	$26,000.00
Number of Profiles — 120	
Cost Per Profile	$216.66

While using HAWTHORNE BITS . . .

XYZ SEISMIC CONTRACTORS, INC.
Rocky Mountain Division
INVOICE: March, 1954

Recording Costs	$ 9,800.00
Cost of Drills (3)	6,450.00
Other Costs, including bits	6,250.00
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Number of Profiles — 180	
Cost Per Profile	$125.00

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Continental Oil Bldg. Denver, Colorado Phone: AComa 8506 TWX: DN 327

315 No. Wolcott St. Casper, Wyoming Phone: 2-3538 TWX: CP 284

111 No. 30th St. Billings, Montana Phone: 9-6661 TWX: BL 12

214 Broadway Bismarck, No. Dakota Phone: 3975 TWX: BM 41

New Catforming Unit

The Atlantic Refining Co. has completed the first Catforming unit on the east coast, with a productive capacity of 500,000 gallons of high octane gasoline daily. This completes the initial phase of a $50 million modernization program. Now being constructed are a synthetic ammonia plant, the first in the Philadelphia area, a catalytic cracking unit which will be the largest of its type in the world, a huge distillation unit with a running capacity of 50,000 barrels of crude oil daily, and an aviation alkylate unit.

Hydrogen from the new Catforming unit will be combined with nitrogen obtained from the air to produce 100 tons of ammonia per day. The new Catformer was charged with 40,000 pounds of catalyst, containing 2,680 ounces of platinum valued at $250,000.

New Pump Laboratory

One of the world's largest, most complete and flexible hydraulic test laboratories of its kind has been completed and placed in operation at the Harrison Works of Worthington Corp. The laboratory covers over 20,000 square feet at the 43-acre Harrison plant and has been over three years in the planning and building. The laboratory is capable of duplicating hydraulic field conditions for the more than 10,000 different types and sizes of pumps currently being produced. Pumps tested will range in size from fractional horsepower units to those with capacities in excess of 100,000 gpm.

Davidson Heads Filtrol Sales

Robert C. Davidson has been appointed sales manager of Filtrol Corp., Los Angeles, succeeding the late Stanard R. Funsten. Sales and service representatives have been assigned as follows: H. D. Bartholomew and L. I. Richardson, Chicago; Gerald Mansfield, Denver; Walter Kitchens and J. E. Leehey, Houston; George Benck, Jackson, Miss.; M. J. Kerchmer and J. D. Barton, Los Angeles; I. A. Schwint, Wilmington, Del.; and L. C. Trescott, Woodbury, N. J.

Dr. Egloff to Receive Award

The 1954 Carl Engler Medaille, Germany's highest award in the field of mineral oil science, will be awarded to Dr. Gustav Egloff, director of research for Universal Oil Products Co. He will be the first scientist living outside of Germany to receive the award. Dr. Egloff will receive the medal in October during the annual congress of the German Institute of Petroleum and Coal to be held in Essen, West Germany.

Appointed to Southwest Research Institute Staff

William D. Thomas, an authority on chemical additive agents for petroleum products, has been appointed to the staff of Southwest Research Institute. He will be fuels and lubricants technologist for the department of chemistry and chemical engineering. He came to the Institute from American Cyanamid Company's petroleum chemical department in New York City.

Reed Roller Bit Appointment

Edward E. Atkisson has been named division field engineer for the Reed Roller Bit Co. in the Tri-States area with headquarters at Salem, Ill. He will serve the drilling industry in a territory covering Illinois, Kentucky, Indiana, Michigan and Pennsylvania.

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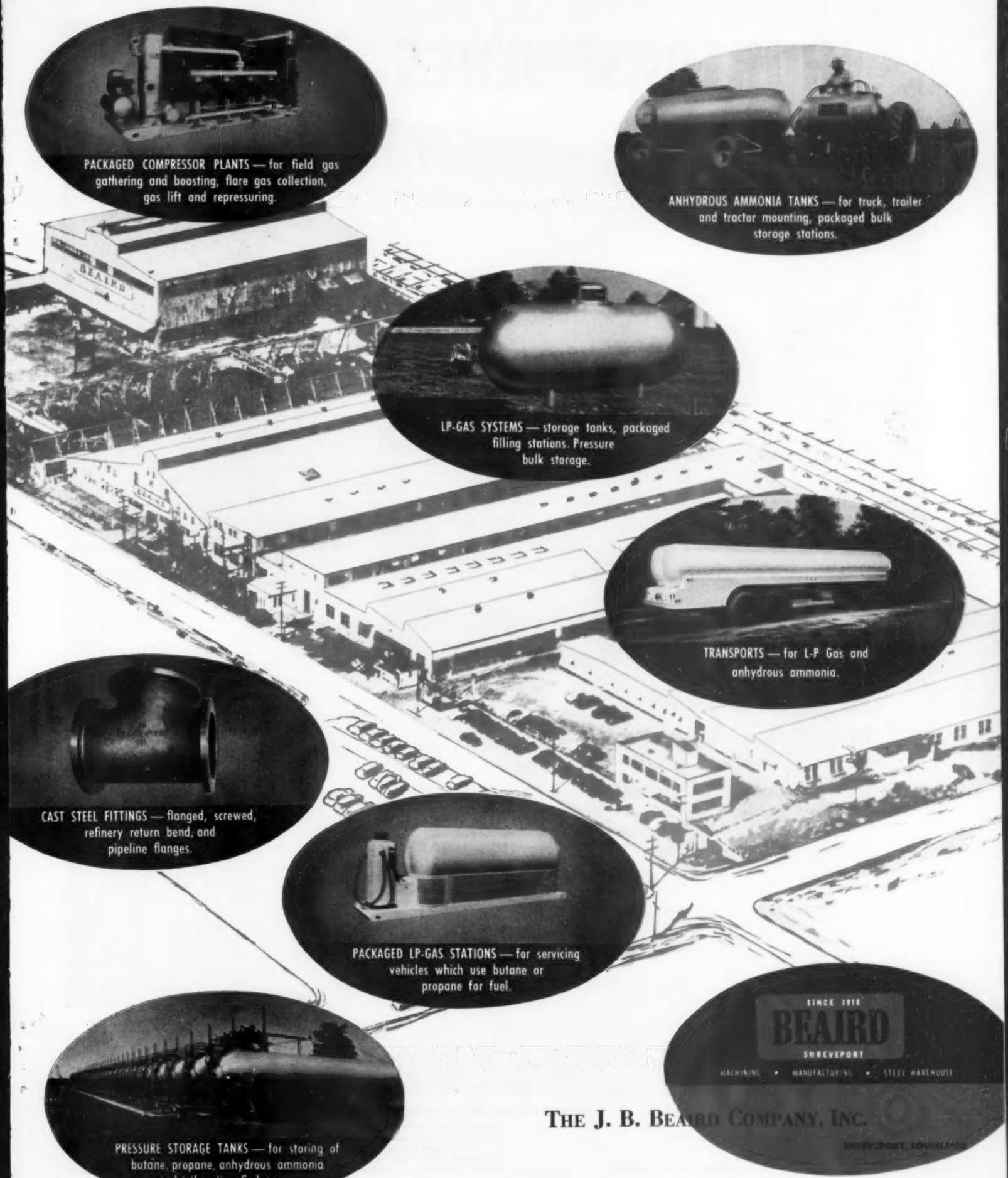

PACKAGED COMPRESSOR PLANTS — for field gas gathering and boosting, flare gas collection, gas lift and repressuring.

ANHYDROUS AMMONIA TANKS — for truck, trailer and tractor mounting, packaged bulk storage stations.

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SINCE 1918

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SHREVEPORT

MACHINING • MANUFACTURING • STEEL WAREHOUSE

THE J. B. BEAIRD COMPANY, INC.

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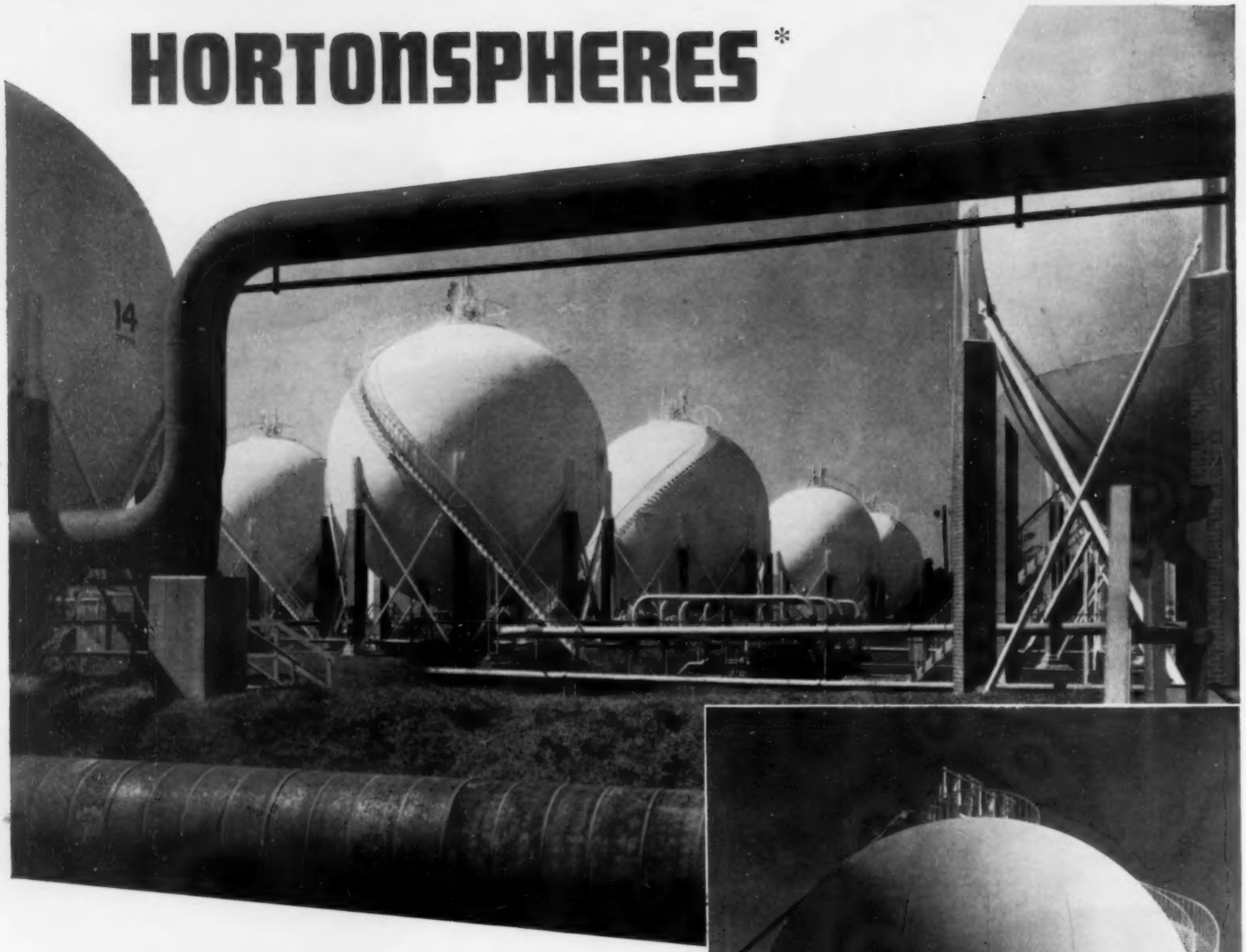
HORTONSPHERES*



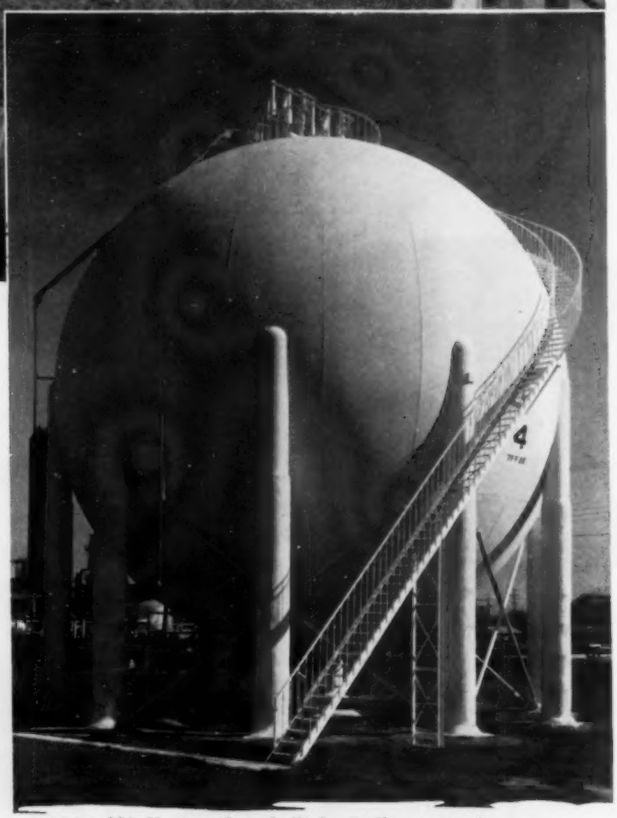
*the answer to volatile hydrocarbon storage problems

Volatile hydrocarbons just cannot be stored at atmospheric pressure and temperature . . . without excessive vapor losses. It's an old problem in the petroleum industry and the modern answer is storage in Hortonspheres.®

The Hortonsphere is the best structure for storing the more volatile hydrocarbons when high pressures are required. Designed to withstand internal pressure, a Hortonsphere does not allow contents to escape as long as the pressure does not exceed the setting of the relief valves.

A Hortonsphere provides dependable service and is entirely free from operating difficulties due to severe weather conditions. With the exception of the relief valves and gages, there are no moving parts in the structure.

Hortonspheres are built in sizes up to 30,000-bbls. and for pressures up to 217 lbs. per sq. in. in the smaller capacities. Write our nearest office for further information.



12,000-bbl. Hortonsphere built for 75 lbs. per sq. in. pressure.

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HUDSON *Solo-aire* UNITS

FOR OIL REFINERY PROCESS COOLING

In this modern South Texas Refinery 80% of the unrecovered heat from the topping unit is dissipated directly to the air thru Hudson Solo-aire exchangers. The use of Solo-aire units for air-cooling all streams leaving the topping unit, including residuum at about 600° F, obviates the circulation of about 7000 gallons per minute of cooling water, and eliminates maintenance expense due to scale deposition and corrosion usually encountered in water cooling of high temperature streams.

Hudson Solo-aire units, equipped with HUDSON HY-FIN bi-metal tubes are designed for refinery services, incorporating features to assure uninterrupted performance with low operating and maintenance costs.

Units pictured below are used for condensing and cooling

GASOLINE
NAPHTHA
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BURNING OIL
GAS OIL
RESIDUUM

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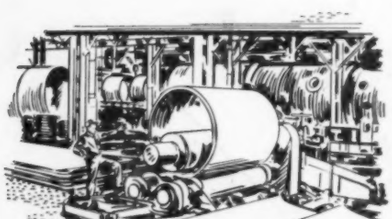

● Within a few hours after loading was completed at Wyatt's Dallas plant, this Platforming Unit was at the refinery site.

It's another instance of doing things the Wyatt Way.

The quicker the delivery, the sooner the Profit.

Wyatt's
HOUSTON-DALLAS-NEW YORK-TULSA

MANUFACTURERS AND ERECTORS SINCE 1913